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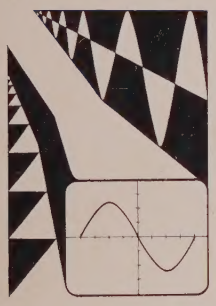

RADIO
LAB

R0209

100 MHz Oscilloscope with Dual delayed timebase and event counter

PM 3263

Instruction manual

9499 440 19502

781110

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Instruction manual
Gerätehandbuch
Notice d'emploi et d'entretien

100 MHz Oscilloscope with Dual delayed timebase and event counter

PM 3263

9499 440 19502

781110

IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparations)

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

Note: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

Bemerkung: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

Remarques: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

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Positive feedback

Now you are the user of a Philips test and measuring instrument. We trust that it will give you many years of faithful service. But we would like you to realize one thing: we can only supply the best in T & M equipment with **your** help, user.

We need to know what you have found to be the strong and weak points of this instrument; and we would be very interested to hear about any unusual or elegant applications you have devised for it. Some of this information can be passed on to our design and development departments; and some may be fed back to other users via our bimonthly publication **T & M News**.

May we therefore suggest that you fill in the reply card alongside and send it back to us right now. (or, - even better - make a note in your diary to fill in the reply card in say 6 months. After you have gained some experience in using the instrument in practice). That way, you'll be helping to provide the positive feedback we need to help you!

All contributions that are published will be paid for at current rates; while as an inducement for you to fill in the reply card, we are offering a free subscription to T & M News or a free copy of Part I of our Digital Instrument Course to all who reply.

Erfahrungsaustausch

Meßgeräte müssen sich in der Praxis bewähren und die in sie gesteckten Erwartungen erfüllen; auch bei Ihnen, dem Besitzer eines Geräts aus der Serie der Philips Test- und Meßgeräte. Wir aber können T & M-Geräte nur zu Ihrer vollen Zufriedenheit herstellen, wenn wir alle Ihre Wünsche kennen.

Deshalb interessiert uns Ihre Meinung über die guten und weniger guten Eigenschaften dieses Gerätes. Außerdem suchen wir Erfahrungen über ungewöhnliche oder neue Anwendungsmöglichkeiten. Vielleicht können Sie unseren Entwicklungs- und Konstruktionsabteilungen einen guten Wink geben; vielleicht können wir Ihre Erfahrungen aber auch in unserer Publikation Info-dienst (nur in Deutschland) veröffentlichen, damit auch andere Anwender davon profitieren können.

Deshalb möchten wir Sie bitten, die anhängende Antwortkarte auszufüllen und an uns zurückzusenden. (Entweder gleich oder -noch besser - machen Sie sich eine Notiz auf Ihrem Kalender und schicken die Karte in einem halben Jahr zurück, wenn Sie genügend praktische Erfahrungen mit dem Gerät gesammelt haben). Damit helfen Sie uns, und wir können Ihnen helfen!

Alle veröffentlichten Beiträge werden dem üblichen Tariff entsprechend honoriert. Als Dank für das Ausfüllen der Antwortkarte bieten wir Ihnen ein Freiabonnement auf Info-dienst (nur in Deutschland) oder ein kostenloses Exemplar von Teil I von unserem Kursus Digital Instrument.

L'intérêt du "feedback"

Vous voilà possesseur d'un instrument d'essai et de mesure Philips. Nous espérons qu'il vous donnera de nombreuses années de bons et loyaux services, mais nous voudrions attirer votre attention sur un point: ce n'est qu'avec **votre** aide que nous pouvons fournir des matériels d'essai et de mesure de toute première qualité.

Nous avons besoin de savoir quels en sont les points forts et les points faibles que vous avez découverts et nous serions très intéressés d'apprendre quelles applications inhabituelles ou élégantes vous lui avez trouvé. Certains de ces renseignements peuvent être transmis utilement à nos bureaux d'études; certains autres peuvent être communiqués à d'autres utilisateurs par l'intermédiaire de notre publication **T & M News** (édition française seulement en France).

C'est pourquoi nous vous serions reconnaissants de remplir la carte-réponse à côté et de nous la renvoyer (ou, mieux encore, de noter dans votre agenda que vous devez remplir la carte-réponse dans, mettons, six mois, une fois que vous aurez acquis quelque expérience pratique de l'utilisation de l'instrument). De cette façon, vous contriburez à nous fournir le "feedback" dont nous avons besoin pour mieux vous servir!

Toutes les réponses publiées seront payées conformément aux tarifs en vigueur; pour vous inciter à remplir la carte-réponse, nous offrons un abonnement gratuit à T & M News ou un exemplaire gratuit de la première partie de notre cours sur les instruments numériques à tous ceux qui répondront.

Details of user: **Persönliche Angaben:** **Expéditeur:**

Company/
Firma/Société .....
Department/
Abteilung/Service .....
Street/Straße/Rue .....
Box/Postfach/Boîte Postale .....
City/Stadt/Ville .....
Country/Land/Pays .....
Name/Name/Nom .....
Phone/Telefon/Numéro de téléphone .....

Details of instruments: **Gerätedaten:** **Instrument:**

Name/Name/
Désignation .....
Type number/Typennummer/
Numéro de type .....
Serial number/Seriennummer/
Numéro de série .....
Date purchased/Kaufdatum/
Date d'achat .....

What are the main applications for which you use this instrument?
Wofür verwenden Sie dieses Gerät hauptsächlich?
Quelles sont les principales utilisations auxquelles vous affectez cet instrument?

.....
.....

Please, list what you consider to be the **strong points** and the **weak points** of the instrument.
Zählen Sie bitte auf, was Ihrer Meinung nach die **guten Seiten** und was die **schwachen Stellen** dieses Geräts sind.
Veuillez énumérer ce que vous considérez être les **points forts** et les **points faibles** de l'instrument.

.....
.....
.....

Do you have any queries about the use of this instrument? If so, what?
Haben Sie irgendwelche Fragen über die Anwendung dieses Geräts? Wenn ja, welche?
Avez-vous des questions à poser sur l'emploi de l'instrument? Si oui, lesquelles?

.....
.....
.....

I have devised an interesting application for this instrument.

- ☐ I enclose a brief description (up to about 500 words) of this application
- ☐ Please, send a representative to collect information about the application

Ich habe einen interessanten Verwendungszweck für dieses Gerät gefunden.

- ☐ Eine kurze Beschreibung hiervon (max. ca. 500 Wörter) erhalten Sie anliegend.
- ☐ Senden Sie bitte jemanden, der sich an Ort und Stelle über den Verwendungszweck informieren kann.

J'ai trouvé une application intéressante pour cet instrument

- ☐ Je joins une brève description (500 mots environ au maximum) de cette application.
- ☐ Veuillez envoyer un représentant à qui nous donnerons des renseignements sur l'application.
- ☐ I would like to receive **T & M News** regularly.
- ☐ Please send me Digital Instrument Course Part I.
- ☐ Ich möchte Info-dienst regelmäßig beziehen.
- ☐ Senden Sie mir Digital Instrument Course, Teil I.
- ☐ J'aimerai recevoir **T & M News** régulièrement.
- ☐ Envoyez moi la première partie du cours sur les instruments numériques.

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T & M News
N.V. PHILIPS' GLOEILAMPENFABRIEKEN
S & I TQ III - 2
Test and Measuring Instruments Department
Att. Mr. T. Sudar
EINDHOVEN
The Netherlands

please fold

T & M News is your feedback unit

T & M News is a bimonthly publication issued by the Test & Measuring Department of Philips' Science & Industry Division, for distribution to actual and potential users of Philips' T & M equipment. It provides an effective means of exchanging information in the T & M field - both from the manufacturer to the customer and **vice versa.**

Apart from T & M **News itself,** we also issue **T & M News Supplement,** (only in English) which provide a vehicle for (generally longer) articles of a more specialized and/or theoretical nature to supplement the information given in **T & M News.** These supplements, being of a more specialized interest, are generally send to a more restricted group of users; though anyone who is interested can obtain them on request.

One special series that just appeared in T & M News Supplements was our Digital Instrument Course (Part I: Basic binary theory and logic circuits; Part II: Digital counters and timers; Part III: Digital voltmeters and multimeters), which proved so popular with readers that each part of the course has been re-issued in booklet form (only in English).

Info-dienst für Ihren Erfahrungsaustausch

Info-dienst (nur in Deutschland) ist eine Publikation der Philips GmbH Unternehmensbereich für Elektronik für Wissenschaft und Industrie für die jetzigen Besitzer und potentiellen Kunden von Philips T & M-Geräten. Dieses Blatt strebt einen effektieven Informationsaustausch auf dem T & M-Gebiet zwischen Hersteller und Anwender sowie **umgekehrt** an.

Neben diesen Info-dienst geben wir auch die **T & M News Supplements** heraus (nur in englischer Sprache), in denen (im allgemeinen längere) Artikel mehr spezieller bzw. theoretischer Art als Ergänzung zu den Informationen in Info-dienst stehen. Diese Supplements, an denen in allgemeinen nur Spezialisten interessiert sind, werden an eine begrenzte Anwendergruppe verteilt. Jeder, der daran interessiert ist, kann sie auf Anfrage erhalten.

Eine spezielle Serie, die gerade in den T & M News Supplements erschienen ist, war unser Digital Instrument Course (Teil I: Basic binary theory and logic circuits; Teil II: Digital counters and timers; Teil III: Digital voltmeters and multimeters). Diese Serie war bei den Lesern so populär, daß jeder Teil von diesem Kursus auch in Buchform herausgegeben wurde (nur in englischer Sprache).

T & M News est notre moyen de communiquer mutuellement

T & M News est une publication de département de Mesure de Philips, destinée aux utilisateurs effectifs et un puissance d'appareils d'essai et de mesure Philips. Elle constitue un moyen efficace de transmettre de l'information dans ce domaine, aussi bien du fabricant vers le client que **vice versa.**

A part la publication **T & M News proprement dite,** nous diffusons les **T & M News Supplements** (seulement en anglais) qui contiennent des articles (généralement plus longs) de nature plus spécialisée ou plus théorique, destinés à compléter l'information donnée dans **T & M News.** Etant donné leur nature, ces suppléments ne sont généralement envoyés qu'à un cercle plus restreint d'utilisateurs; toutefois, quiconque s'y intéresse peut les obtenir sur demande.

Nous venons de publier dans les T & M News Supplements une série spéciale d'articles qui constituent un cours sur les instruments numériques (1ère partie: Théorie binaire de base et circuits logiques; 2ème partie: Compteurs numériques et minuteries; 3ème partie: voltmètres et multimètres numériques) qui a rencontré un tel succès auprès des lecteurs que chaque partie du cours a été réimprimée sous forme de livret (seulement en anglais).

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Operating manual

1. GENERAL INFORMATION

1.1. INTRODUCTION

The PM 3263 is a two channel, portable, high sensitivity, wide band oscilloscope, with micro-processor controlled timing facilities.
These facilities include:

- Dual delayed time-base
- Event count triggering for both main- and delayed time base
- Frequency measurements

Time- and frequency measurement-results, and the selected number of events to be counted, are displayed in a 6-digit LED display. More-over the LED display shows ERROR or UNCAL messages in case of operator's errors.
Further facilities are: Trigger view, Alternate time-base display and Automatic TTL triggering.
Alternate time-base offers a simultaneous display of a signal on two different time-base scales provided by main time-base and delayed time-base.
The oscilloscope is provided with many integrated circuits which guarantee stable operation and reduce the number of adjusting points.
The supply voltage can be set to two ranges, 90 V to 140 V and 180 V to 265 V by means of a switch.
All these features make the oscilloscope suitable for a wide range of applications.

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Front view PM 3263

1.2. CHARACTERISTICS

This instrument has been designed and tested in accordance with IEC Publication 348 for Class 1 instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings that shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition. This specification is valid after the instrument has been warmed up for 30 minutes. Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average instrument.

Designation	Specification	Additional Information
1.2.1. C.R.T.		
– Type	PHILIPS D14-300GH/37	Rectangular tube face, domed mesh type, post-accelerator, metal-backed phosphor
Measuring area	80 x 100 mm	
– Screen type	P31 (GH) phosphor	P7 (GM) or P11 (BE) phosphor optional
Photographic writing speed	1500 cm/μs	Typically 2000 cm/μs Measured with Steinheil Oscillophot M5 camera; aperture: 1:1,2 object-to-image ratio 1:0,5 film: Polaroid 410 (10.000 ASA) No pre-fogging Phosphor type P31 (GH)
Total acceleration	17 kV	
Graticule	Internal	Continuously variable illumination
Engravings:	Centimetre divisions with sub-divisions of 2 mm along the central axes. Dotted lines at 1,5 and 6,5 div. from top of display provide measuring lattice for checking rise-time.	
– Trace rotation	Screw-driver adjustment available on front panel.	
1.2.2. Vertical or Y-deflection		
– Response (2 mV range excepted)		
Frequency range	d.c. to 100 MHz a.c. 10 Hz to 100 MHz	–3 dB upper bandwidth limit –3 dB Frequency range includes 10:1 probe over 20-30 °C
Rise-time	3,5 ns	Over 6 divisions, +5 - +40 °C
Pulse aberrations	± 3 % peak-peak	
For 2 mV/DIV spec. refer to end of section 1.2.2.		
– Deflection coefficient	2 mV/div. ... 5 V/div.	Eleven calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1:⩾2,5. Uncal. lamp signalling.
Accuracy	± 3 %	

Designation	Specification	Additional Information
– Maximum permissible input voltage	± 400 V	d.c. + a.c. peak. Derating at frequencies above 500 kHz. See Fig. 1.3.
Maximum undistorted deflection	24 divisions	Up to 35 MHz
Shift range	16 divisions	8 divisions each in upward and downward direction from the central horizontal line of graticule.
– Input impedance	1 Megohm ± 2 %//15 pF approx.	Input A and B equally adjusted
Input RC time	22 ms	AC input coupling
Trace stability	0,1 div./hour	+20 - +40 °C temperature range
Trace jump	0,2 div.	When switching between any of the attenuator positions.
Trace jump	0,5 div.	When operating the NORM/INVERT switch.
Trace shift	0,2 div.	When rotating the continuous attenuator. 0,4 div. in 5 mV/DIV setting.
Trace shift	1 div.	When switching to the ADDED position. 0,4 div. in 5 mV setting. Increasing when rotating the continuous attenuator.
Long-term temperature drift	$< 20\ \mu V/^{o}C$	Typical value measured at 2 mV over 4 div.'s.
– Visible signal delay	15 ns approx.	
– Display modes	Channel + or – A only Channel + or – B only Trig. view only Channels ± A and ± B chopped Channels ± A and ± B alternated Channels ± A and ± B added ± A, ± B and Trig. view chopped or alternated (3 channels display)	If Trig. view display is selected in combination with alternate time-base display, this will be automatically displayed in main time-base intensified mode. Refer also to Fig. 1.5.
– Chopper frequency	1 MHz	Display time per channel 350 ns approx.
– Cross-talk between channels	1:500	Up to 50 MHz
– Common mode rejection factor	Better than 100 up to 2 MHz	Measured with +A and –B added
	20 at 50 MHz	Max. common-mode signal 8 divisions.
– Trigger view		
Display	External or internal signal	
Frequency response	$\geqslant$ 80 MHz	
Deflection coeff.	Same as vertical	
External	100 mV/div. ± 3 %	

Designation	Specification	Additional Information
External ÷ 10	1 V/div. ± 5 %	
Internal	Vertical ± 10 %	
Trigger point	Screen centre ± 0,3 div.	Coupling d.c.
Aberrations	± 10 % peak-to-peak	
Time delay between vertical input and external input	3 ns ± 1 ns	
– Specification of 2 mV/DIV setting		
Deflection coefficient	2 mV/Div.	
Error limit	± 5 %	
Frequency range	DC 0 - 35 MHz AC 7 Hz - 35 MHz	–3 dB upper bandwidth limit –3 dB
Rise-time	10 ns	
Pulse aberration	± 5 % peak-to-peak	
Common mode rejection factor	Better than 100 up to 2 MHz	
Trace stability	0,25 div./hour	+20 - +40 °C temperature range
Trace jump	1 div.	When switching between 2 mV/DIV. and 5 mV/DIV.
Trace jump	2 div.	When operating the NORMAL/INVERT switch.
Trace shift	1 div.	When rotating the continuous attenuator.
Trace shift	1 div.	When switching to ADDED position.

1.2.3. Horizontal or X-deflection

– Display modes	– Main time-base – Main time-base intensified by delayed time-base – Delayed time-base – Main TB intensified and delayed TB alternately displayed – X-Y and X-Y/Y operation	With possibility of trace separation of 4 divisions X deflection by: – Channel A signal – Channel B signal – Signal applied to EXT connector of main TB – Line voltage

For dual-delayed time base and event-counting refer to section 1.2.6.

– Horizontal position drift in x1 position	0,2 div./hour	The horizontal position drift with the magnifier in the x1 position, shall not exceed 0.1 div./hour over +20-+40 °C temperature range. The same stability requirement applies to the start of the sweep during variation of the sweep speed setting, with exception of highest sweep ranges (50-100 ns/div.).
– Horizontal position control	± 5,2 div. from screen centre	The horizontal shift control combines coarse and fine adjustment.

	Designation	Specification	Additional Information
1.2.4.	**Main Time-base**		
	— Operation	Automatic	Automatic free running in the absence of triggering signals, after less than 0,1 sec.
		Triggered Single sweep	
	Sweeptime coefficients	1 s/div. ... 50 ns/div.	23 calibrated position in a 1-2-5 sequence. Uncalibrated continuous control 1:≥2,5 between steps. One uncal. lamp for both MTB and DTB.
	— Coefficient error	± 2 % ± 3 %	+20 °C ... +30 °C + 5 °C ... +40 °C
			The difference in sweep accuracy over any two divisions of 10 div. sweep is ± 5 %, excluding the first and last div. at the 5 ns and 10 ns magnified sweep rates.
	— Variable hold-off	The sweep hold-off time can be increased by a factor of 10.	The hold-off time is minimal if knob fully clock-wise (CAL). The knob is combined with X AMPL control.
	— Expansion	10x	Switched, calibrated. The display section, which coincides with the central horizontal graticule line shall not shift more than one div. when the horizontal magnifier is changed from x1 to x10.
	Coefficient error	± 1 % additional	First and last 50 ns of 5 ns/div., 10 ns/div. and 20 ns/div. magnified sweep rates ± 5 %.
	Max. effective time coefficient	5 ns/div.	
1.2.5.	**Delayed time-base**		
	— Operation	Normal	Started by MAIN TB or, Triggered.
		Dual	Started by MAIN TB.
	— Sweeptime coefficient	0,5 s/div. ... 50 ns/div.	22 calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1:≥2,5 between the steps. One uncal. lamp for both MTB and DTB.
	Coefficient error	± 2 % ± 3 %	+20 °C ... +30 °C + 5 °C ... +40 °C
			Difference in sweep accuracy over any two divisions of 10 div. sweep is ± 5 %, excluding the first and last div. at the 5 ns and 10 ns magnified sweep rates.
	— Expansion	Identical to main time-base specification.	

Designation	Specification	Additional Information
1.2.6. Delay Modes		
– Delay	Delayed time-base starts immediately after the delay time.	LED display shows delay time.
or	Delayed time-base triggers after delay time.	LED display shows UNCAL 1
– ΔT (interval)	Delayed time-base starts after Delay time and after Delay + ΔT time.	LED display shows ΔT time interval.
1/T	ΔT or delay time inverted	LED display shows the frequency of of a signal if ΔT, or Delay time coincides with one period of that signal.
– Events before DTB	Delayed time-base is triggered after counting a number of events	LED display shows selected number of events.
– Events before MTB	Main time-base is triggered after counting a number of events.	LED display shows selected number of events.
– Events before MTB combined with delay, ΔT or 1/T	Main time-base is triggered after counting a number of events.	LED display shows the value belonging to the last selected function. Previous functions and values are stored in the memory. Triggering of delayed time-base not possible.
Delay, ΔT, 1/T	Variable between 0X and 10X the time coefficient of the MTB	LED display shows a time, by 4 (or 3) digits with exponent, or if MTB continuous control is not in CAL position a number of divisions. If DTB is triggered LED display shows UNCAL 1.
Resolution	5.10^{-4} of 10X main time-base setting.	MTB sweep in CAL position. In UNCAL position resolution is 0,05 mm.
Jitter	1:30.000	

Accuracy

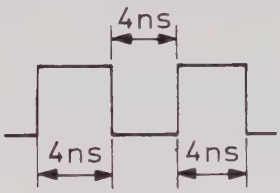
Delay	ΔT	1/T
± 1 % of range	± 1 % of reading	± 1 % of reading
– A °/oo of range	– A °/oo of range	– A °/oo of range*
+ initial delay of 20 ns	± 0,25 °/oo of range	± 0,25 °/oo of range

* A depends on main time-base setting
A = 1,5 in settings starting at 5
A = 0,5 in settings starting at 1
A = 0 in settings starting at 2

Additional error in main time-base positions 50 ns/div. and 100 ns/div. resp. ± 3 % and ± 1 %.

Long term stability	< 2 div. at 1000x	Ratio between MTB and DTB sweep-time 1000.

Designation	Specification	Additional Information
ΔT	Variable between 0x and 10x the time coeff. of the MTB	Time difference ΔT between the delayed sweeps is displayed, indicated by 4 (or 3) digits + ten's exponent. ΔT is read in sec. or if the MTB is out of calibrated position, in Div.'s. If the DTB is triggered LED display shows UNCAL 1. The second delayed sweep can never be set before the first delayed sweep. If a time interval is set and the setting of the first delayed sweep is changed (after release of the ΔT-button) the time interval is stored in the memory even if this interval is beyond the limit of the MTB The stored time interval is called back by pressing the ΔT button. The indication of the LED display will under no circumstances be higher than the difference between 10x the MTB setting and the delay of the first delayed time-base.
1/T	The LED display shows the inverted value of Delay time or ΔT time. Minimum distance between the markers: 0,1 div. 1 div.	1/T is read in Hz and indicated by 4 (or 3) digits and ten's exponent. If the MTB continuous control is not in CAL position the LED display shows UNCAL 3. x1 magn. x10 on. If the distance is too small the LED display shows UNCAL 2.
Events before DTB	Number of events can be set between 0 and 99999.	Number of events is continuously controllable by the SET potentiometer. Display counter speed is proportional to angle of rotation of potmeter and variable between 1 and 50 pulses per second and, in pushed position between 100 and 5000 pulses per second. If number of pulses set by the potentiometer is greater than the number of pulses displayed on one MTB sweep, the NOT TRIG lamp of the DTB will glow up. If in the event mode trigger source MAIN TB has been selected the LED display will indicate this by showing ERROR.
Events before MTB	Number of events can be set between 0 and 99999 Events before MTB can be combined with Delay, ΔT or 1/T modes.	MTB triggering releases the counter while pulses to be counted are processed by the DTB triggering.

Designation	Specification	Additional Information
Pulse conditions	Max. event rate 125 MHz Min. pulse width 4 ns Min. pulse space 4 ns	 Fig. 1.1. Max. event rate 125 MHz
Set up times	Refer to Fig. 1.2.	
1.2.7. X deflection via Y_A or Y_B		Uncalibrated continuous control 1:⩾2,5.
– Deflection coefficient	2 mV/div. ... 5 V/div.	
Coefficient error	± 5 %	
Bandwidth	0-2 MHz	–3 dB bandwidth for 8 div.'s deflection.
Maximum undistorted deflection	20 divisions	up to 0,1 MHz
Phase difference with respect to Y display	3 °C at 0,1 MHz	
1.2.8. External X-deflection via EXT socket		
– Deflection coefficient		
External	50 mV/div.	Uncalibrated continuous control
External ÷ 1-	500 mV/div.	1:3 with x AMPL control. Calibrated in fully clockwise (CAL) position.
Input characteristics	Identical to Y inputs	
Accuracy	± 3 %	Additional 2 % for Ext. ÷ 10.
Bandwidth	DC ... 2 MHz 7 Hz .. 2 MHz	Via DC trigg. coupling Via LF or HF trig. coupling.
Phase difference w.r.t. Y-channels	3° at 0,1 MHz	
Linearity	1,5 %	
Drift	0,2 div./hr.	
1.2.9. Triggering of the Main Time-base		
Trigger source	Internal from channel A Internal from channel B Composite A and B Internal from line External External ÷ 10	Alternate vertical mode only.
Trigger modes	Automatic	Automatic free-run of the time-base generator approx. 0,1 s after disappearance of the trigger signal.
	Triggered	
	Single sweep	
Not trig'd lamp	Indicates the not triggered state of the main time base. In single sweep mode the lamp is on after main time-base reset, and extuingishes at the end of the sweep.	
Slope	+ Or –	

Designation	Specification	Additional Information
Trigger sensitivity	Internal: 0,5 div. up to 30 MHz 1,5 div. up to 100 MHz 2 div. up to 150 MHz	Typical sensitivity as a function of frequency, see Fig. 1.4.
	External: 50 mV up to 30 MHz 150 mV up to 100 MHz 200 mV up to 150 MHz	
	External ÷ 10: Typical 10x higher values than in position EXT.	
Trigger modes and coupling	DC: full bandwidth LF int: 0-30 kHz LF ext: 7 Hz - 30 kHz HF: 30 kHz - 100 MHz TTL	Both internal and external –3 dB –3 dB –3 dB both internal and external Automatic TTL triggering Level control not functioning.
TTL levels	Internal triggering (A, B or Comp.) Low: 0,8 div. (± 0,4 div.) High: 2 div. (± 0,4 div.) Gap: 1,2 div.	
	External triggering (EXT) Low: 0,8 V (± 0,4 V) High: +2 V (± 0,4 V) Gap: 1,2 V	These data apply to voltages on the tip of a 1:10 attenuator probe connected to the EXT input socket with trigger source selector in EXT position.
Level range	Internal trigg: 24 div. External trigg: +1,2 V to –1,2 V External ± 10: +12 V to –12 V	
Input impedance	Identical to Y inputs	
Trigger jitter	Better than 0,5 ns	

1.2.10. Triggering of the Delayed Time-base

Source	Internal from channel A Internal from channel B External Main TB	Other characteristics are identical to TRIGGERING OF THE MAIN-TIME BASE. Except Ext. ÷ 10 and line trigg.
Not trig'd lamp	Indicates the not-triggered state of the delayed time-base.	

1.2.11. Calibration Output

Voltage	3 V_{p-p}	
Current	6 mA	Through current loop
Error limit	± 1 %	Both voltage and current
Freqeuncy	2 kHz ± 2 %	
Protection	The output is protected against continuous short-circuiting.	

Designation	Specification	Additional Information
1.2.12. Additional Input and Outputs		
Z-Modulation input	DC coupled TTL compatible response time 35 ns. input impedance 10 kΩ max. input voltage 50 V	Logic high blanks out the display
Main TB Gate output	+5 V during MTB sweep, otherwise "0" V.	Output impedance 1 KOhm.
Delayed TB Gate output	+5 V during DTB sweep, otherwise "0" V.	Output impedance 1 KOhm.
1.2.13. Power Supply		
Line voltage	100-127 Va.c. ± 10 % 220-240 Va.c. ± 10 %	Automatically protected against incorrect setting of line voltage selector.
	250 Vd.c. - 350 V d.c.	Line voltage selector in either position.
Line frequency	46 to 440 Hz	
Power consumption	60 W	
Build-in line fuse	2 Amps. delayed action	Located on rear panel.
Power transients	Damage to the oscilloscope shall not occur under voltage and frequency transient conditions specified in MIL-T-28800.	

1.2.14. Environmental Characteristics

The characteristics are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS-organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, THE NETHERLANDS.

– *Temperature tests*

In accordance with IEC 68 Ab and Bb.
Operation: −15 °C to +55 °C.
Operation within specification: +5 °C to +40 °C. Exceptions on tolerances to be indicated per spec. point.
Storage: −55 °C to +75 °C.

– *Altitude*

In accordance with IEC 68-2-13 test M.
Operation: to 15.000 feet (5000 m.)
Derating: 1°C/1000 feet for the max. operating temperature.
Storage: to 50.000 feet (17.000 m.)

– *Humidity*

In accordance with IEC 68 Db following the standard Philips oscilloscope test program; also comparison with MIL-E-1640F 5 cycles (120 hours) has to be made.

Designation	Specification	Additional Information

– *Shock*

Operating: 30 g, half-sine, 11 ms duration, 2 shocks per axis per direction for a total of 12 schocks.

– *Vibration*

Operating: 15 minutes along each of 3 axes.
0,025 inch p-p displacement (4 g at 55 Hz) with frequency varied from 10 Hz to 55 Hz, in one minute cycles.

– *Recovery*

Operates within 30 minutes of being brought from −10 °C soak, into room condition of 60 % R.H. at 20 °C.

– *Magnetic Shielding*

In accordance with IEC 351-22.3.1.
A maximum deviation of 1 div.

– *Interference*

VDE 0871 and 0875, störgrad K.

1.2.15. Mechanical Data

– Dimensions	Length 460 mm. (18 1/8 inch)	Excluding controls, cover and feet.
	Width 316 mm. (12 1/4 inch)	
	Height 154 mm. (6 1/8 inch)	
– Weight	10,7 kg (23 1/2 lbs)	

1.3. ACCESSORIES

1.3.1. Accessories delivered with the instrument

– Two passive 10:1 probes
– Contrast filter
– Front cover with storage space
– Collapsible viewing hood (PM 9366)
– Banana - BNC adapter (PM 9051)
– CAL terminal - BNC adapter
– Manual

1.3.2. Optional accessories

PM 8921	Passive probe set 1 : 1 (1,5 m)
PM 8921L	Passive probe set 1 : 1 (2,5 m)
PM 8935	HF passive probe set 10 : 1 (1,5 m)
PM 8935L	HF passive probe set 10 : 1 (2,5 m)
PM 8932	Passive probe set 100 : 1
PM 8940	Isolation amplifier
PM 8943	Fet probe 1 : 1, 10 : 1, 100 : 1
PM 8994	Set of accessories for probes
PM 9355	Current probe: 1 mA/div. ... 1 A/div.; 12 Hz ... 70 MHz
PM 9346	Power supply for active probes
PM 8960	19 inch rack mount adaptor
PM 8992	Accessory pouch
PM 9380	Oscilloscope camera
PM 8971	Adapter for oscilloscope camera
PM 8910	Polaroid anti-glare filter
PM 8980	Long type viewing hood
PM 8901	Battery pack 24 V d.c. and 280 V d.c.
PM 8991	Oscilloscope trolley

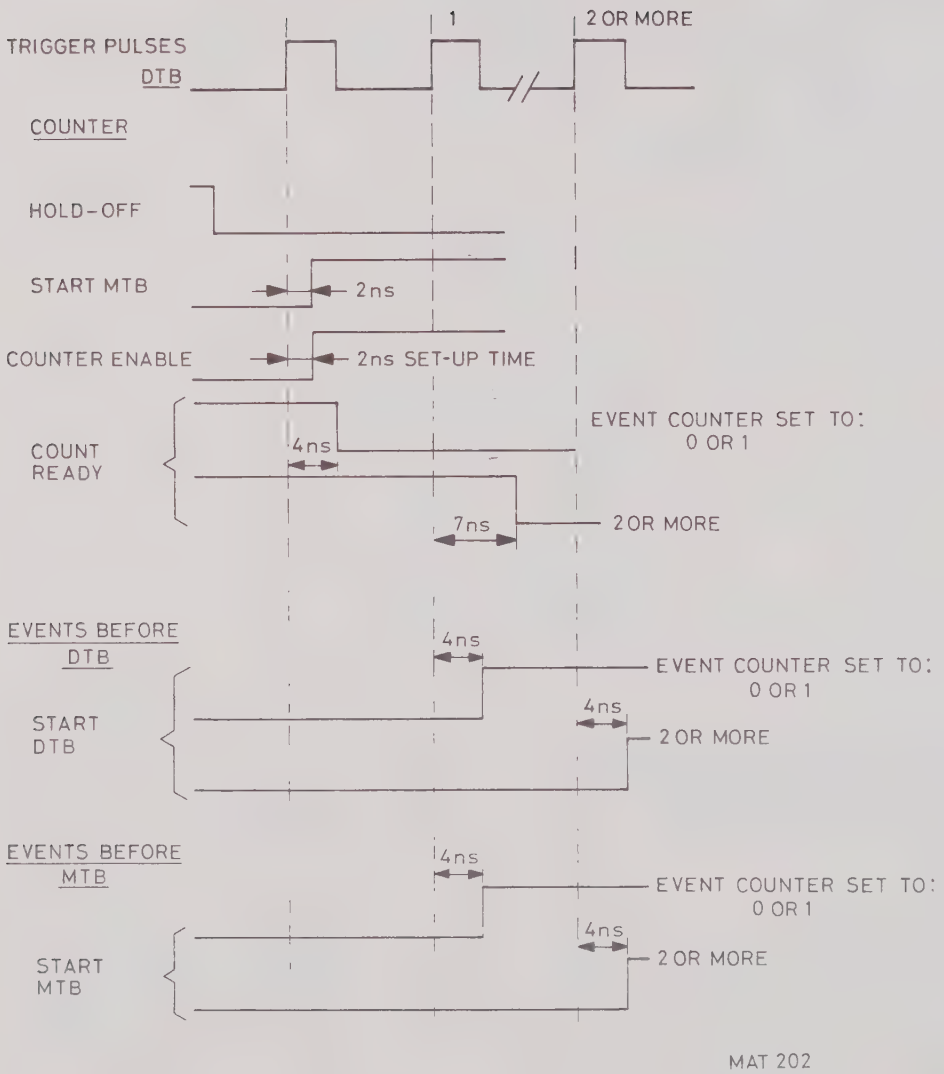


Fig. 1.2. Set up times.

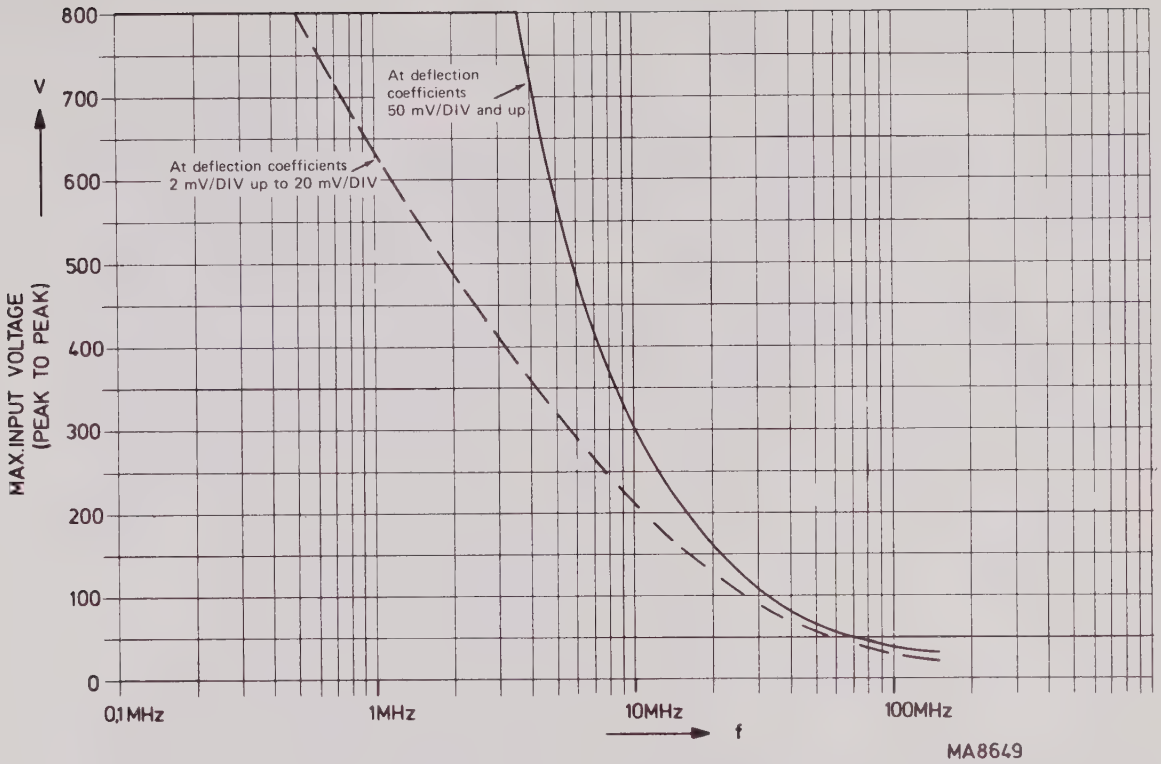


Fig. 1.3. Derating of the maximum permissible input voltage as a function of frequency

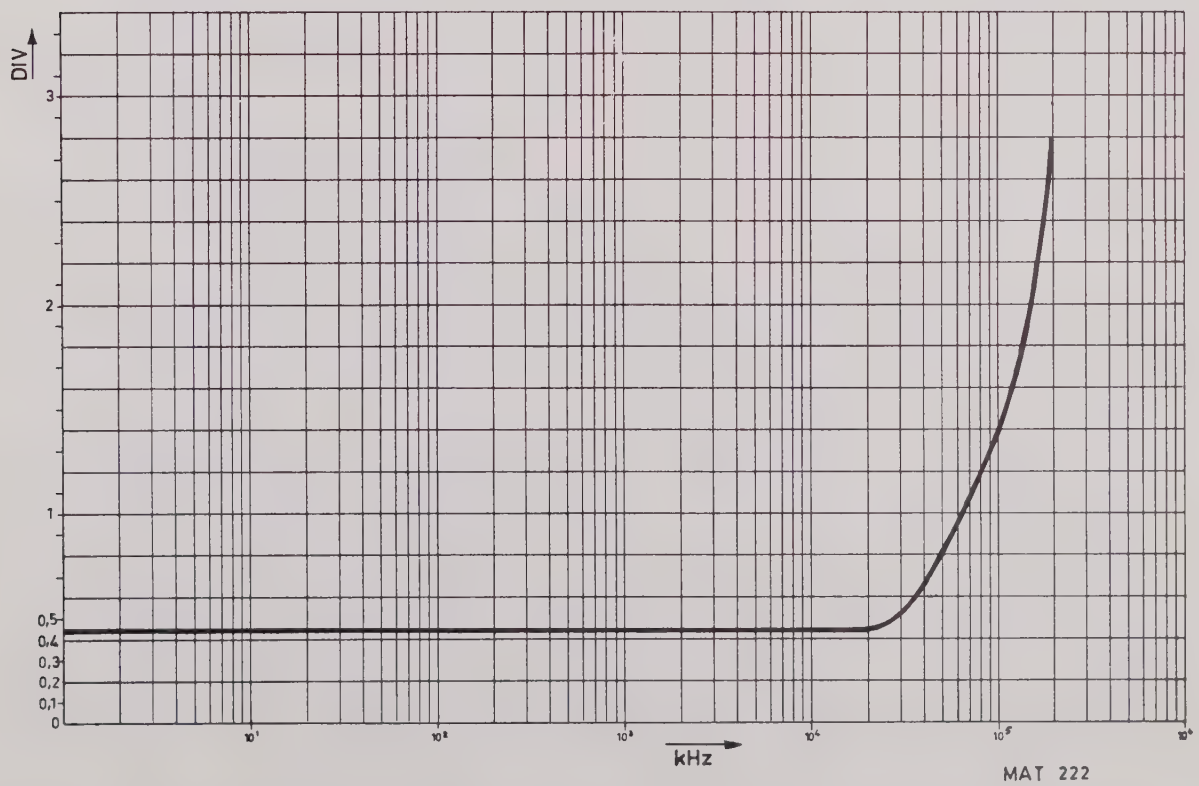
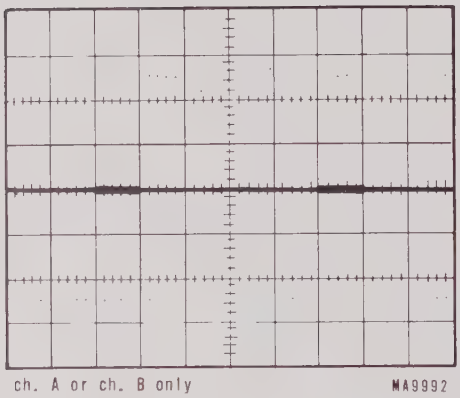
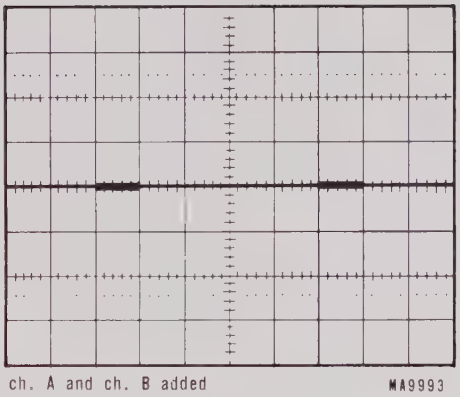


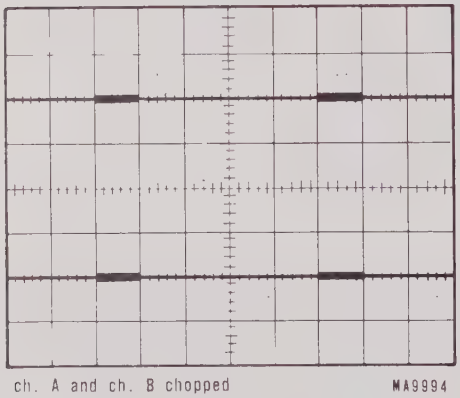
Fig. 1.4. Typical trigger sensitivity of channel A as a function of frequency.



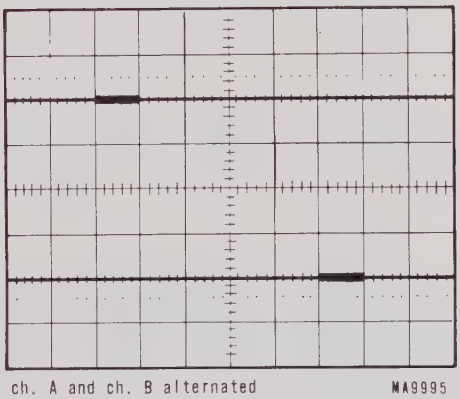
1) Ch. A or ch. B only



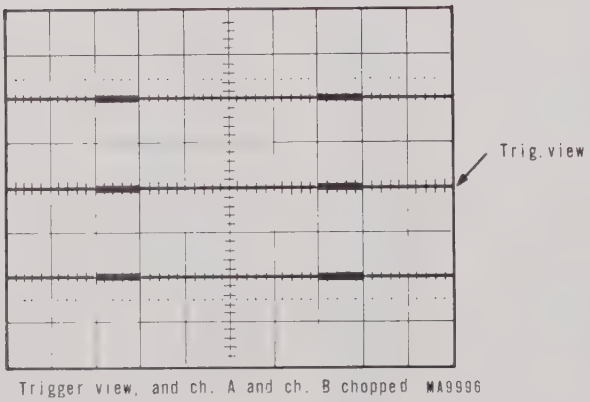
2) Ch. A and ch. B added



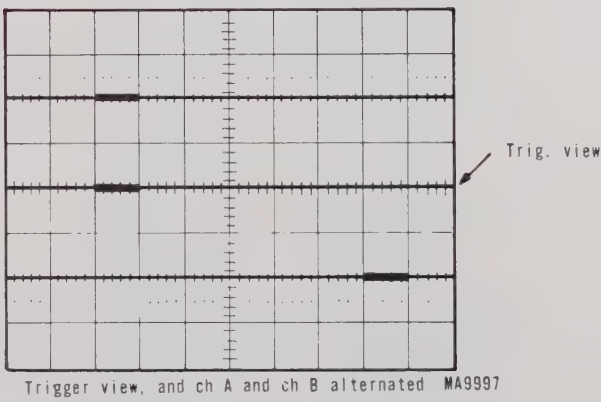
3) Ch. A and ch. B chopped



4) Ch. A and ch. B alternated



5) Trigger view, and ch. A and ch. B chopped



6) Trigger view, and ch. A and B alternated

Fig. 1.5. Summary of display modes with dual delayed time-base

2. OPERATING MANUAL

2.1. GENERAL INFORMATION

This section outlines the procedures and precautions necessary for installing the PM 3263, identifies and briefly describes the functions of the front and rear panel controls and indicators, and explains the practical aspects of operation to enable an operator to evaluate quickly the instrument's main functions.

2.1.1. Mains adjustment and fuse

Set the mains adaptor switch, located behind the rear plate, to the relevant supply voltage range.
The fuse-holder, which is mounted on the rear panel, carries a 2 A delayed action fuse. Ensure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse-holders shall be avoided. The instrument shall be disconnected from all voltage sources when a fuse is to be replaced.

2.1.2. Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following ways:

- via the protective earth terminal at the rear (identified by the symbol ⏚);
- via the earth wire in three-core mains cable.

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor.
Replacing the mains plug is at the user's own risk.

WARNING: Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal is likely to render the instrument dangerous.
Intentional interruption is discouraged.
When using this instrument "floating" keep in mind that the whole cabinet carries the voltage to which the ground clip of the probe has been connected.
When an instrument is brought from a cold to a warm environment, condensation may cause a hazardous condition. Ensure, therefore, that the earthing requirements are strictly adhered to.

2.1.3. Installation

Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (see section EARTHING).

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals, which can be dangerous to life.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair is effected with the instrument open. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved. Bear in mind that the capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

2.1.4. Carrying handle

The handle can be rotated if the push-buttons on its bearings are depressed. The text in the handle bar explains the ERROR and UNCAL messages in the LED display.

2.1.5. Front cover

Removing:
- Rotate the knob in the centre of the cover a quarter-turn anti-clockwise to UNLOCKED position.
- Remove the cover

Fitting:
- Rotate the knob to the UNLOCKED position
- Fit the cover over the front of the oscilloscope.
- Press and rotate the knob a quarter-turn clock-wise to LOCKED position.

The room in the front cover is available to accommodate accessories such as probes, collapsible viewing hood.

To open the front cover press both tongues of the locking device and lift the inner plate.

2.1.6. Switching on

The POWER switch is incorporated in the graticule ILLUM control on the front panel, immediately below the screen bezel. The associated POWER ON/OFF indicator lamp is adjacent to the ILLUM control.
The oscilloscope must never be switched on whilst any circuit board is removed.
Never remove a circuit board until the oscilloscope has been switched off for at least one minute.

2.1.7. Power-on test

When switching on, the microprocessor initiates an automatic test of internal circuits, including:

- processor test
- prom test
- ram test
- display test

The result of these tests is shown in the LED display:
A 8 . appears from left to right on each digit for a period of 0,5 sec.
After this the EV, DIV and S or Hz lamps light up for 0,5 sec.

If the microprocessor controlled circuits are not working properly, the following test results are shown on the LED display:

- Display remains blanked :

Processor test probably failed.

A 0 in right most digit:
PROM test failed

A / in right most digit:
RAM test failed

2.2. EXPLANATION OF CONTROLS AND SOCKETS

2.2.1. Vertical deflection and C.R.T. section

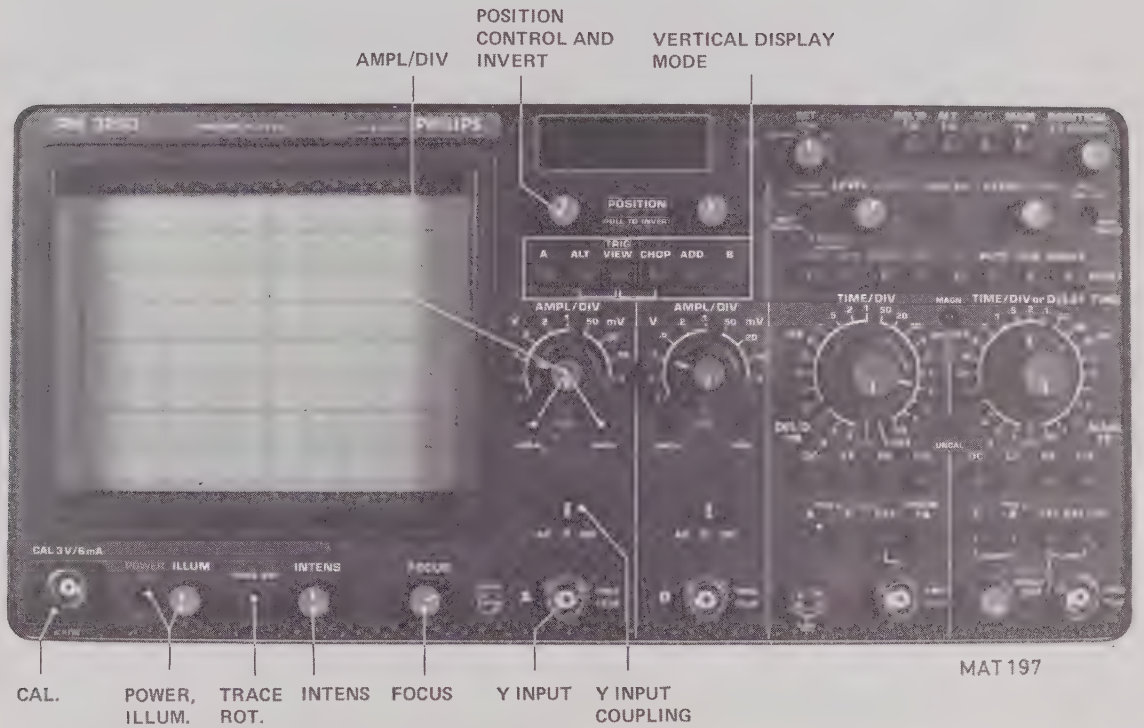


Fig. 2.1. Vertical deflection and c.r.t. section

VERTICAL DEFLECTION

– Vertical display mode	Selects the desired vertical deflection
A depressed	Vertical deflection is achieved by the signal connected to the input of channel A.
ALT depressed	The display is switched over from one vertical channel to the other at the end of every cycle of the time-base signal; i.e. the A and B channels are displayed on ALTernate sweeps.
TRIG VIEW depressed	The display is switched to view the selected trigger signal. Trigger view display can be internal via A or B channels (A or B depressed) or external via external input socket, when EXT or EXT/10 is depressed. Trigger view can only be combined with chopped or alternate display.
CHOP depressed	The display is switched over from one vertical channel to the other at a fixed frequency, both A and B channels being displayed during the same sweep.
ADD depressed	Vertical deflection is achieved by the sum signal of channels A and B.
B depressed	Vertical deflection is achieved by the signal connected to the input of channel B.
ALT and TRIG VIEW depressed simultaneously	The signals on channels A, B and TRIG VIEW are displayed during alternate sweep; usually suitable for high frequency signals (see also explanation of push-button TRIG VIEW).

CHOP and TRIG VIEW depressed simultaneously	The signals on channel A, B and TRIG VIEW are displayed one after the other at the CHOP frequency during the same sweep; usually suitable for low frequency signals. (See also explanation of push-button TRIG VIEW)
All pushbuttons out	If no pushbutton is depressed, the instrument operates in the ALT mode.
– Position control and invert	
POSITION	Continuously variable control giving vertical shift of the display.
PULL TO INVERT	2-way push-pull switch, integral with the POSITION control, for the inversion of the signal polarity. Control is depressed for NORMAL and pulled for INVERT.
– AMPL/DIV	Step control of the vertical deflection coefficients; 11-way switch. In the 2 mV/DIV position the bandwidth is limited to 35 MHz.
CAL (AMPL/DIV)	Continuously variable control of the vertical deflection coefficients. In the CAL position the selected deflection coefficient is calibrated.
UNCAL	Pilot lamp indicating that the CAL control is not in the CAL position.
GAIN (screw-driver control)	Calibration of the gain in the CAL position.
– Y input coupling	
AC, 0, DC	Signal input coupling; 3-way switch.
AC	Coupling via a blocking capacitor
0	Connection between input circuit and input socket is interrupted and the amplifier input is earthed to establish a O-reference.
DC	Direct coupling
– Input	
A 1M - 15 pF	BNC input socket for channel A.
B 1M - 15 pF	BNC input socket for channel B.
C.R.T. SECTION	
CAL.	Output providing a 3 Vp-p 2 kHz square-wave voltage, to calibrate vertical deflection AMPL control, or for frequency compensation of voltage divider probes.
	Current loop with 6 mAp-p for calibration of current probes.
POWER, ILLUM	Continuously variable control of the graticule illumination, incorporating the power on/off switch.
POWER ON	Pilot lamp indicating that the power switch is on.
TRACE ROT (screw-driver control)	Preset control for aligning the trace with the graticule line.
INTENS	Continuously variable control of the trace brilliance.
FOCUS	Continuously variable control of the c.r.t. electron-beam focusing.

2.2.2. Horizontal deflection

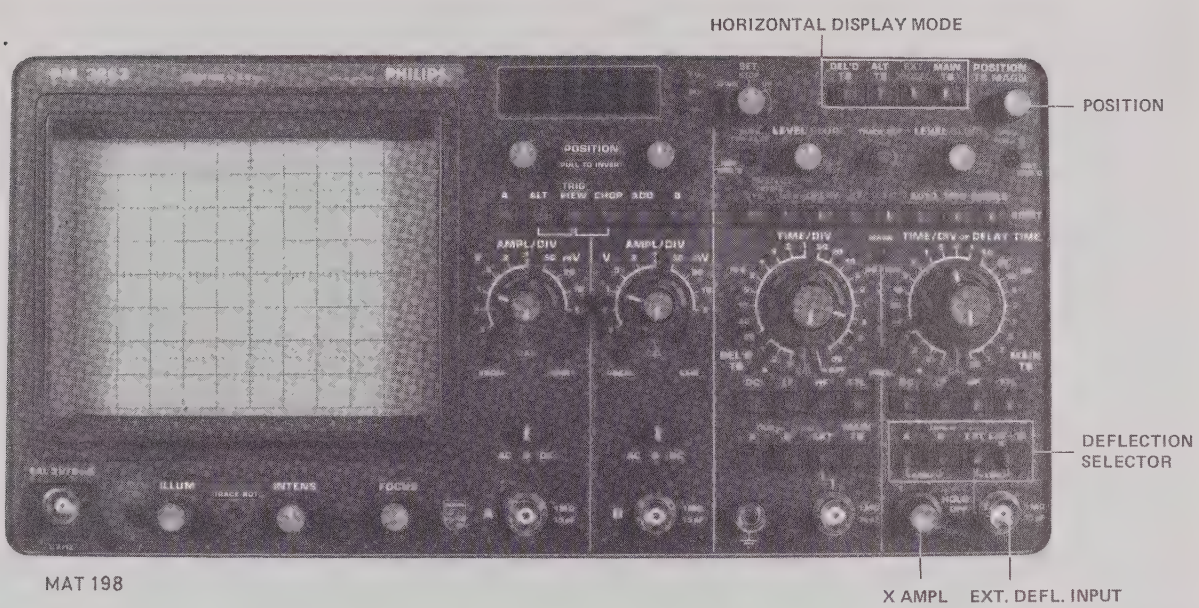


Fig. 2.2. Horizontal deflection

– Horizontal display mode	Selects the desired horizontal deflection.
DEL'D TB depressed	The horizontal deflection voltage is supplied by the delayed time-base generator.
ALT TB depressed	The horizontal display is switched over from the main time-base to the delayed time-base at the end of every sweep and so on. If ALT TB is combined with TRIG VIEW the display will be MAIN TB intensified.
EXT X DEFL depressed	Horizontal deflection is achieved by an external signal applied to the input socket of the horizontal amplifier, by the channel A or B signals, or by a mains-frequency (LINE) signal, depending on the TRIG or X DEFL pushbutton selection.
MAIN TB depressed	The horizontal deflection voltage is supplied by the main time-base generator. A part of the trace is intensified (except in the OFF position of the TIME/DIV switch of delayed time-base generator).
All pushbuttons out	Effectively the same as MAIN TB depressed.
– POSITION (TB MAGN)	Continuously variable control giving horizontal shift if the display; incorporates a push-pull switch for increasing the horizontal deflection coefficient by a factor of 10. (PULL FOR X10).

– TRACE SEP	Continuoulsy variable Adjusting of the vertical distance between the two traces in ALT TB mode.
– Deflection selector	External X deflection or main time-base trigger source selector. X-deflection only when button EXT X DEFL of the horizontal display mode switch has been depressed.
A depressed	X-deflection internally from channel A.
B depressed	X-deflection internally from channel B.
EXT depressed	The signal at the external input is used for X-deflection.
EXT ÷ 10 depressed	Same as above but via a build-in 1 to 10 voltage divider.
LINE (both EXT and EXT ÷ 10 depressed)	X-deflection internally from the line voltage.
– EXT DEFL INPUT	Input socket for external X-deflection.
– X AMPL	Variable control of the X-deflection amplitude in the EXT X DEFL mode, combined with hold-off control. Normally this knob is in the CAL position.

2.2.3. Main Time-base

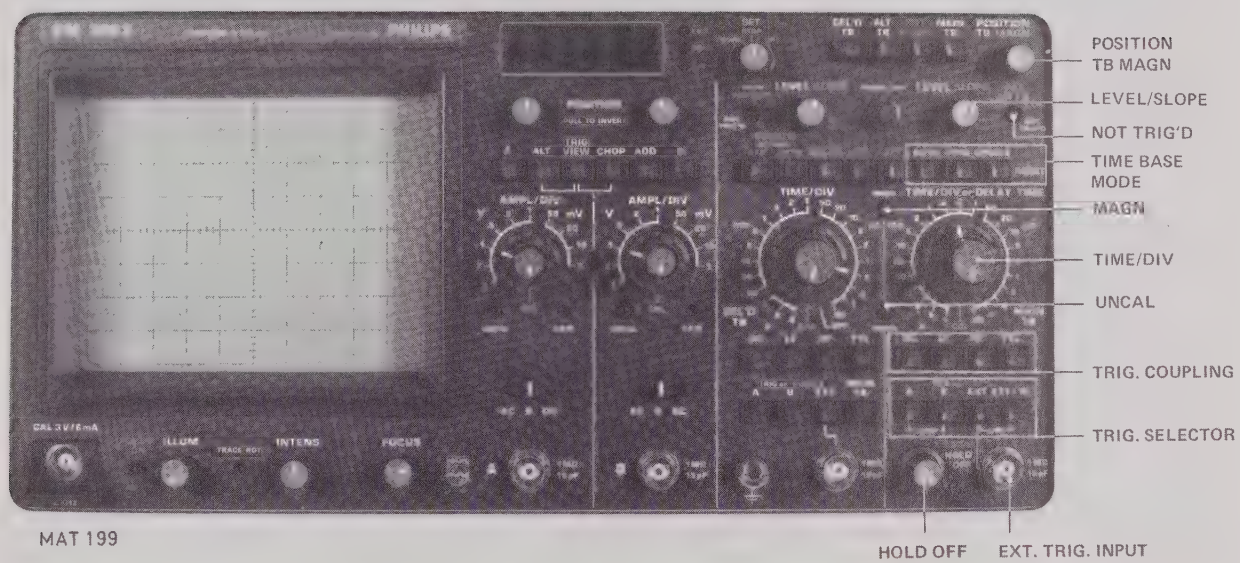


Fig. 2.3. Main time-base

TB MAGN	Push-pull switch to increase the horizontal deflection coefficient by a factor of 10 (PULL FOR X10)
LEVEL-SLOPE	Continuously variable control for selecting the level of the triggering signal at which the time-base generator starts. This control incorporates a push-pull switch that enables choice of triggering on either the positive- or negative-going edge of the triggering signal (IN +, OUT –).
NOT TRIG'D	Pilot lamp indicating that the time-base generator is in the waiting position.
– AUTO, TRIG, SINGLE	Trigger mode controls; 3-way pushbutton switch.
AUTO depressed	The main time-base is free-running in the absence of trigger signals.
TRIG depressed	The time-base generator is normally triggered.
SINGLE, RESET	Pressing this button puts the main time-base in the single sweep mode. After receipt of a trigger pulse the main time-base runs only once. By pressing this button again the main time-base is reset to be ready for the next trigger pulse.

If no button is depressed the circuit operates effectively as if the SINGLE mode has been selected.

– MAGN	Pilot lamp indicating that the x10 magnifier is on; applies to both main - and delayed time-base
– TIME/DIV	Time coefficient control of the main time-base; 23-way rotary switch.

CAL (blue) - TIME/DIV	Continuously variable control of the main time-base coefficients. In the CAL position the time coefficient is calibrated.
UNCAL	Pilot lamp indicating that the CAL control is not in the calibrated position; applies to both main and delayed time-base.
– TRIG COUPLING	4-way pushbutton switch.
DC depressed	Full trigger bandwidth (DC included).
LF depressed	Trigger coupling via low-pass filter from DC up to 30 kHz (for external triggering via band-pass filter of 7 Hz to 30 kHz).
HF depressed	Trigger coupling via a high-pass filter for frequencies higher than 30 kHz.
TTL depressed	Trigger coupling adapted to TTL levels. Level control out of service. For levels refer to: "Characteristics".

With no pushbutton depressed, the circuit operates effectively as with the DC button depressed.

– TRIG SELECTOR	4-way pushbutton switch.
A depressed	Internal triggering on channel A.
B depressed	Internal triggering on channel B.
COMP (both A and B depressed)	Internal triggering on channel A and channel B. Only in Y-ALT mode.
EXT depressed	Trigger on external signal via adjacent ext. trig. input socket.
EXT ÷ 10 depressed	Same as above but via a build-in 1 to 10 voltage divider.
LINE (both EXT and EXT ÷ 10 depressed)	Triggering internally from the line voltage.
EXT TRIG INPUT	Input for external triggering.
– HOLD OFF	This knob permits control of the main time-base hold-off time and allows perfect triggering on e.g. double-pulse signals. Normally this knob is in the CAL position. Rotating the knob away from the CAL position increases the hold-off time. Combined with variable X AMPL.

2.2.4. Delayed Time-base

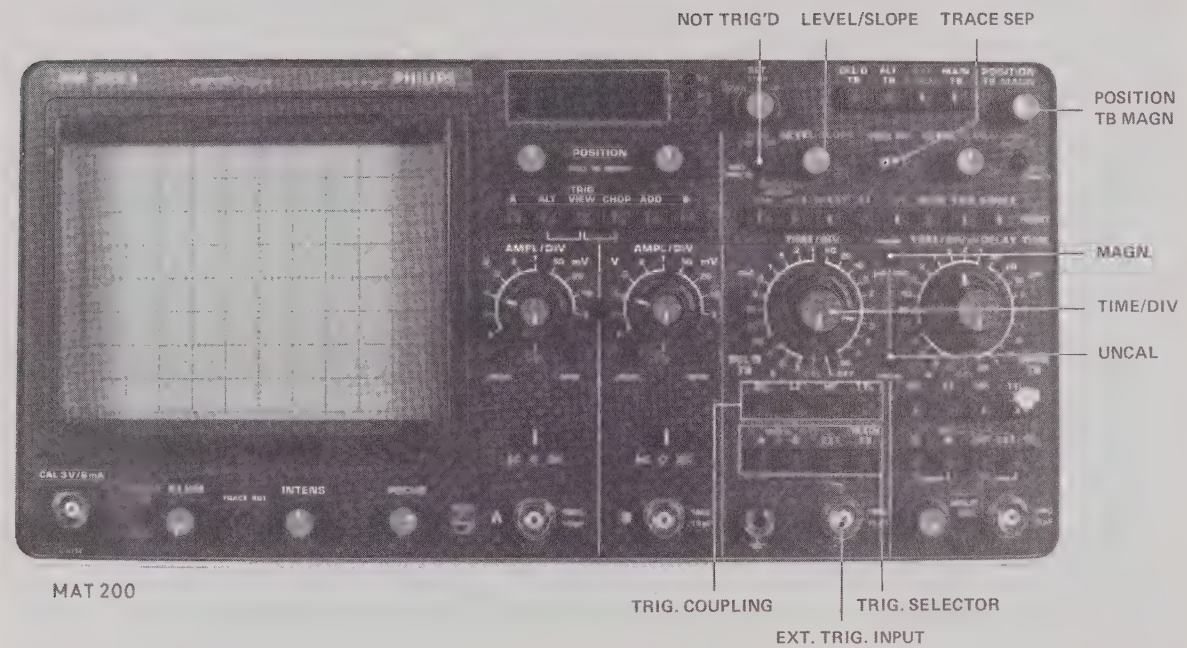


Fig. 2.4. Delayed time-base

POSITION TB MAGN	Continuously variable control giving horizontal shift of the display; incorporates a push-pull switch for increasing the horizontal deflection coefficient by a factor of 10 (PULL FOR X10).
TRACE SEP.	Continuously variable control of the separation between the two time-base displays in the ALT TB mode.
LEVEL-SLOPE	Continuously variable control for selecting the level of the triggering signal at which the time-base generator starts. This control incorporates a push-pull switch that enables choice of triggering on either the positive- or negative-going edge of the triggering signal (IN +, OUT –).
NOT TRIG'D	Pilot lamp indicating that the time-base generator is in the waiting position.
MAGN	Pilot lamp indicating that the X10 magnifier is on; applies to both delayed- and main time-base.
TIME/DIV	Time-coefficient control of the delayed time-base; 23-way rotary switch. Incorporates an OFF position whereby the delayed time-base is switched off.
CAL (blue) - TIME/DIV	Continuously variable control of the delayed time-base generator time coefficients. In the CAL position the time coefficient is calibrated.
UNCAL	Pilot lamp indicating that the CAL control is not in the calibrated position.

– TRIG COUPLING	4-way pushbutton switch.
DC depressed	Full trigger bandwidth (DC included)
LF depressed	Trigger coupling via low-pass filter from DC up to 30 kHz (for external triggering via band-pass filter of 10 Hz to 30 kHz).
– HF depressed	Trigger coupling via a high-pass filter for frequencies higher than 30 kHz.
TTL depressed	Trigger coupling adapted to TTL levels. Level control out of service. For levels refer to: "Characteristics".

With no pushbutton depressed, the circuit operates effectively as with the DC button depressed.

– TRIG SELECTOR	4-way pushbutton switch.
A depressed	Internal triggering on channel A after delay time.
B depressed	Internal triggering on channel B after delay time.
EXT depressed	Triggering on external signal after delay time, via adjacent ext. trig. input socket.
MAIN TB depressed	Delayed time base starts immediately after delay time.

With no button depressed, the circuit operates effectively as with button A depressed.

– EXT TRIG INPUT	Input for external triggering.

2.2.5. Event Count and Delay

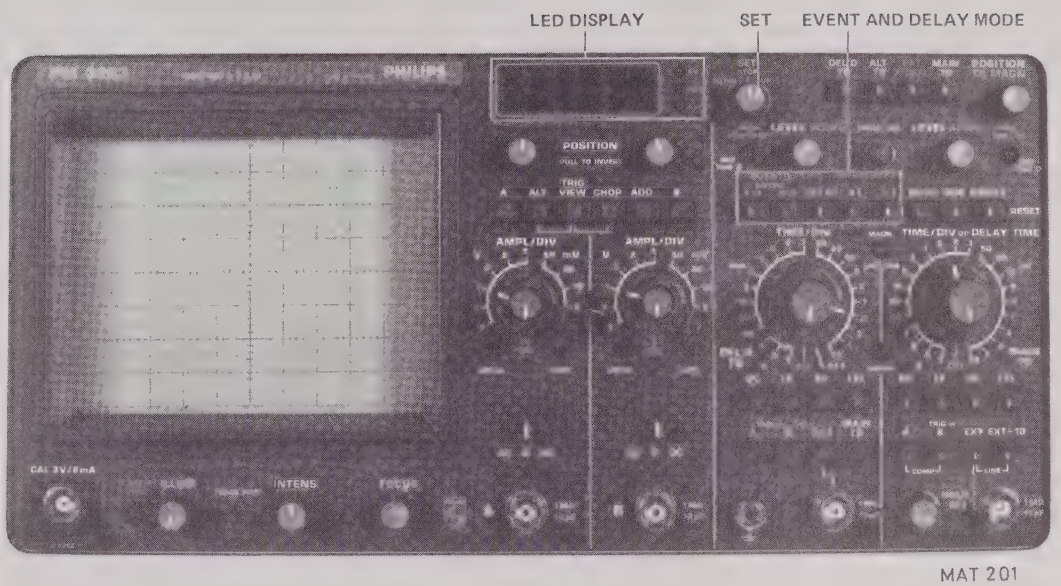


Fig. 2.5. Event count and Delay

– LED display with EV on:	Number of events (pulses) to be counted is shown.
with DIV on:	Number of divisions of the c.r.t. display in DELAY mode and ΔT mode is shown, when the MAIN TB vernier control is not in the CAL position.
with S or Hz on:	A time is displayed if the 1/T knob is not depressed. A frequency is displayed if the 1/T knob is depressed.
Set knob	Controls the number of events to be counted in the event count mode. Controls the DELAY time and the ΔT interval time in these respective modes.
– EVENT AND DELAY MODE switch	
EVENTS BEFORE DTB	The event counter is used to delay the delayed time-base.
EVENTS BEFORE MTB	The event counter is used to delay the main time-base.
DELAY	The delayed time-base starts a certain time after the start of the main time-base.
ΔT	Dual delayed time-base.
(interval time)	The interval time between the two delayed time sweeps is shown in the LED display. Used for time measurements between two points of a complex signal.
1/T	This mode applies only if the DELAY or ΔT mode has been selected. If DELAY or ΔT time is equal to one period of the signal, the LED display shows the frequency of that signal.

2.3. SOME GENERAL INFORMATION ON THE PM 3263's WORKING PRINCIPLES

2.3.1. Inputs A and B

The oscilloscope has been provided with two identical channels, each of which can be used for either YT measurements in combination with one or both time-base generators, or XY measurements in combination with the external horizontal channel.

Y-T measurements

To display one signal, either of the two vertical channels can be selected by operating either push-button A or pushbutton B of the vertical display-mode controls.
When pushbutton ALT or CHOP is depressed, two different signals can be displayed simultaneously. The Y deflection coefficient and the polarity can be selected for each channel individually. When the ALT button is operated, the display is switched over from one channel to the other at the flyback of the time-base signal. Although the ALT mode can be used at all sweep speeds of the time-base generator, the CHOP mode will give a better display quality for long sweep times, because during these long sweep times the alternate display of the two input signals is clearly visible to the eye.

In the CHOP mode, the display is switched over from one channel to the other at a fixed frequency.
If pushbutton ADD of the display mode switch is operated, the signal voltages of both vertical channels are added. Depending on the position of the polarity switches, either the sum or the difference of the input signals is displayed. The ADD mode also enables differential measurements. With these measurements advantage is taken from the common mode rejection in the ADD position. When the polarity switches of both channels are set to opposite positions, the common mode parts of the signals on sockets A and B will undergo a very slight amplification only, with respect to the differential mode parts.

X-Y measurements

If pushbuttons EXT X DEFL of the horizontal display-mode (deflection) controls and A of the TRIG OR X DEFL controls are operated, the time-base generators are switched off. A signal applied to the vertical A channel is then used for horizontal deflection. The AC/0/DC switch and the step attenuator of channel A remain operative. Continuous control of the deflection coefficients is possible with the X DEFL/HOLD OFF control and horizontal trace shift with the X POSITION control.

Vertical channel B may also be used for X deflection.
To this end, the B button of the TRIG OR X DEFL controls is depressed.

It is also possible to use an internal voltage at the mains frequency or a signal applied to the EXT socket at the bottom right-hand side of the front panel for X deflection, after depressing the relevant pushbutton of the TRIG OR X DEFL controls. In these modes the trace width can be controlled with the X AMPL/HOLD OFF potentiometer.
With this potentiometer in its CAL position, the deflection coefficient for external signals is 50 mV/DIV. The external signal can be either d.c. or a.c. coupled (lower frequency limit 7 Hz) by depressing either the DC or the LF pushbutton of the trigger coupling controls of the main time-base.

AC/0/DC switch

The signals under observation are fed to input socket(s) A and/or B and the AC/0/DC switch is set to either AC or DC, depending upon the composition of the signal. As the vertical amplifier is d.c. coupled, the full bandwidth of the instrument is available and d.c. components are displayed as trace shift in the DC position of the AC/0/DC switch.
This may be inconvenient when small signals superimposed on high d.c. voltages must be displayed. Any attenuation of the signal will also result in attenuation of the small a.c. component. The remedy is to use the AC position of the input switch, which employs a blocking capacitor, to suppress the d.c. and l.f. signals. Some pulse drop will occur when l.f. square wave signals are displayed.

The 0 position interrupts the signal and earths the amplifier input for quickly determining the 0 V level.

2.3.2. Time-base

The time-base circuits deliver a sawtooth voltage in order to obtain a linear horizontal deflection. The horizontal deflection speed is calibrated so that an exact time related display can be obtained.
To get a stable display the time-base sawtooth voltage must be started every time at the same point of the wave form (this is called: Triggering).

Main time-base

The main time-base has three modes:

AUTO : The time-base generator circuit is free running if no triggering is present.
As soon as a trigger signal is present a stable display is obtained.

TRIG : The time-base generator is only running if a trigger signal is present.
If no trigger signal the display remains dark.

SINGLE : The time-base generator runs only once after receipt of a trigger pulse. This mode is often used when phenomenae that occur only once must be photographed.
After a single sweep the time-base is set ready for receipt of the next trigger pulse by pressing again the SINGLE button.

Variable hold-off

The hold-off time is the time between the end of a time-base sweep and the moment at which the circuit is ready to trigger on the next trigger pulse.
Normally with complex signals (e.g. double pulse signals) double triggering may occur resulting in an unstable display.
With the aid of the HOLD OFF control the hold-off can be adjusted in order to avoid double triggering.
In the CAL position of this knob the hold-off time is at its lowest value.

Delayed Time-base

The delayed time-base generator is in principle the same as the main time-base generator.
The delayed time-base generator however originates only a sweep during the main time-base sweep.
The delayed time-base is generally used for closer inspection of details in complex signals.
If the DEL'D TB button has been depressed only the delayed time-base sweep is on the display.

When the delayed time-base trigger source button MAIN TB has been depressed, the delayed time-base sweep starts at a certain moment during the main time-base sweep.
The delayed time-base starts then without triggering; the delay time is shown on the LED display.

Due to a possible high ratio between main time-base and delayed time-base sweep times, some jitter may occur if the delayed time-base only is displayed. This jitter can be suppressed by triggering of the delayed time-base (by A, B or EXT). The time in the LED display however is then no longer accurate, so UNCAL 1 is shown.

The PM 3263 oscilloscope features dual delayed time-base (ΔT mode).
Two delayed time-base sweeps are then obtained on one main time-base sweep.
The delayed time-base sweep is usually set to a short time to obtain a marker function.
The delay time and the ΔT time can be shown in the LED display.

Another feature of the PM 3263 oscilloscope is triggering after event counting; possible for both main- or delayed time-base. The number of events (pulses) can be set to any value between 0 and 99999.

The event counter counts only trigger pulses which are present in the delayed time base trigger circuit.
The event counter starts counting at arrival of the main time-base trigger pulse.

Time-base MAGNifier

The time-base magnifier is operated by a push-pull switch incorporated in the horizontal-POSITION control.
If this switch is pulled to position X10, the sweep speed of the time-base generator are increased by a factor of 10. Thus, the portion of the signal displayed over a width equal to one division in the centre of the screen in the x1 position (TB MAGNifier depressed), will occupy the full width of the screen in the x10 position.
Any portion of the trace can be brought on to the screen by the horizontal-POSITION control for scrutinisation.
In the x10 position, the time coefficient is determined by dividing the indicated TIME/DIV value by 10.

If the TB MAGN is switched on, the LED display is not changed but remains in the normal (x1) condition.

Use of the ALTernate TB

The PM 3263 is equipped with display switching. This offers the instrument user a simultaneous display of the signal on the two time scales provided by the main time-base and by the delayed time-base.
Detailed examination of a certain portion of the main time-base display is enabled by expanding the time interval of interest by means of the delayed time-base. Expansion is achieved by selecting a correspondingly faster sweep for the delayed time-base TIME/div. control.

The part of the signal under detailed observation by the delayed time-base remains as an intensified portion of the main time-base display. One can immediately correlate the detail with the overall signal, which may be extremely complex, without the necessity of switching between MAIN TB and DEL'D TB.

Vertical shift between the two-time-base displays is continuously variable with the TRACE SEParation control.

2.3.3. Triggering

If a signal must be displayed, the time base generator(s) must always be started on one fixed point of the signal in order to obtain a stationary display. The time-base generator is, therefore, started by narrow trigger pulses formed in the trigger unit and controlled by a signal originating from one of the vertical input signals, an internal voltage at mains frequency or an external source.

In the trigger unit the trigger pulses are derived by comparing the input signal with an adjustable d.c. voltage (LEVEL).
The trigger level is related to the vertical deflection rate in case of internal triggering (A or B); and to the input voltage in case of EXT triggering.

Trigger coupling

Four different trigger-coupling methods can be chosen with the DC/LF/HF/TTL switch. In the HF and LF positions, the transfer characteristic is limited.
In position DC the trigger signal is passed unchanged.
In position LF, a 0 Hz (7 Hz for external triggering) to 30 kHz band-pass filter is inserted. This position can be used to reduce interference from noise.
In position HF, a 30 kHz high-pass filter is inserted.
This position can be used to reduce interference from e.g. hum.
In position TTL automatic triggering on TTL levels obtained.
The trigger gap is now at a fixed value (the LEVEL control is not functioning).

Trigger source

The trigger signal can be taken internally from channel A or B or externally via the EXT socket. At internally triggering, the trigger signal is not affected by the continuous AMPL control.

Main time-base

The main time-base can also being triggered via a 1 : 10 voltage attenuator circuit allowing higher external trigger voltages.
Composite triggering is choosen by depressing both A and B buttons. In this mode the trigger signal is taken from ch. A or ch. B depending on which channel is on the display.
Note that composite triggering is not applicable in the chopped mode because then the chopped signal will be seen as trigger signal.

Line triggering (= triggering by a signal derived from the mains voltage) is chosen when both buttons EXT and EXT ÷ 10 are depressed.

2.3.4. Microprocessor

The most important tasks for the microprocessor are:

- checking the position of the various front panel controls
- loading the LED display
- loading the event counter
- loading the digital-analog converter to obtain the delayed time-base comparator voltage
- calculating the 1/T value.

2.4. PRELIMINARY SETTINGS

2.4.1. GAIN calibration

- Operate pushbutton A of the display-mode controls.
- Operate pushbutton AUTO of trigger-mode controls.
- Operate pushbuttons MAIN TB of the horizontal deflection controls.
- Display the trace by means of the appropriate POSITION control.
- Set the LEVEL, INTENS and FOCUS controls for a sharp, well-defined display.
- Set the AC-0-DC switch to DC.
- Set the AMPLtude switch to 0.5 V and the continuous control to CALibrated.
- Connect the CALibration socket to the A input socket.
- Check that the trace height is exactly 6 divisions.
  If necessary, readjust the GAIN control on the front panel, immediately below the AMPLitude switch.

If a 1 : 10 voltage attenuator probe is used set the AMPLitude switch to 50 mV/DIV.
Check the square-wave response of the probe.

Repeat for the B-channel.

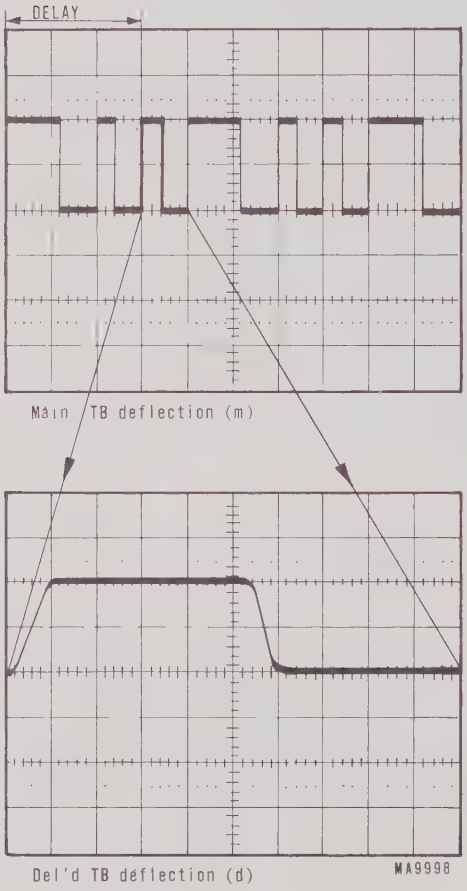
2.4.2. Trace rotation

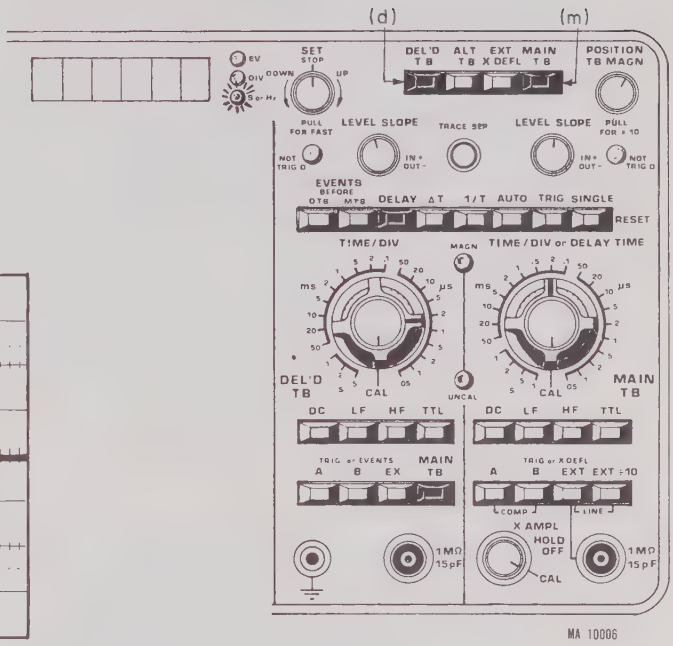
- Depress pushbutton A of the display-mode controls.
- Depress pushbutton MAIN TB of the X-deflection controls.
- Centre the time-base line using the POSITION controls.
- Check that the time-base line runs exactly in parallel with the horizontal graticule line; if necessary, readjust the TRACE ROT control on the front panel.

2.5. DETAILED INFORMATION ON DELAY AND EVENT-COUNT MODES

2.5.1. DELAY mode

In this mode, both the main- and delayed time-base are operating. The delayed time-base sweep is intensified during main time-base sweep.





The delay time after which the delayed time-base starts, is shown in the LED display.
The display shows a mantissa and an ten's exponent.
The exponent can be:
Blanked (0) for seconds
−3 for mseconds
−6 for μseconds.
The delay time is controlled with the aid of the SET knob.

In former models of oscilloscopes the control of the delay time has been realised with a ten-turn calibrated dial which indicated a factor between (0 and 100 %) with which the main time-base sweep time had to be multiplied to obtain the delay time. With this new system however the delay time is directly shown on the LED display.

By selecting the DEL'D TB deflection (d) the delayed time-base sweep is shown over the whole c.r.t.'s display. In this way the start point of the delayed time-base can be exactly set to obtain optimum accuracy of the delay time shown in the LED display.
Note that the maximum value shown on the LED display equals the total main time base sweep time.

As in the above described DELAY mode the delayed time base is started at a certain point*) on the main time-base sweep some jitter may occur. To obtain a jitter-free c.r.t. display the delayed time-base can be triggered by selecting A, B or EXT triggering; however the LED display shows UNCAL 1.

DIV LED

When the MAIN TB vernier control is not in the CAL position the LED display cannot give the DELAY time, instead the DELAY is indicated in a number of divisions on the display.
In this case the DIV lamp is on and the S- or Hz lamp is off.

TB MAGN

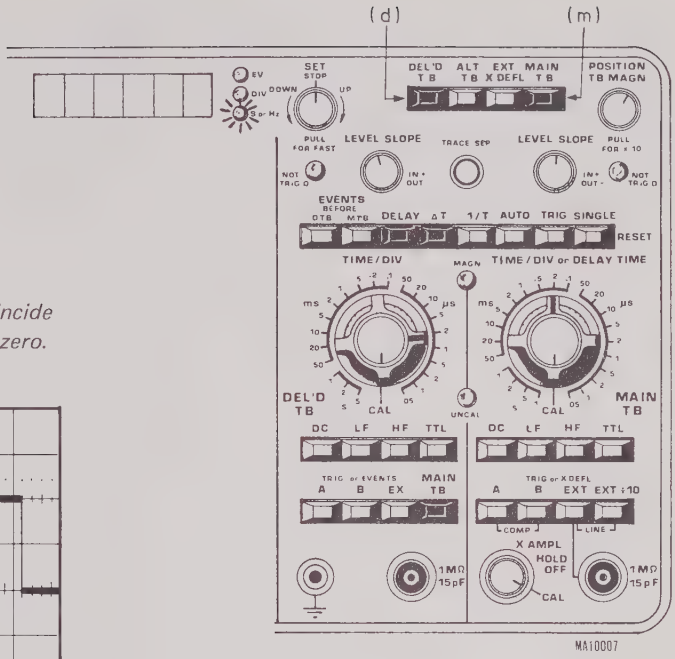
If the TB MAGN is switched on, the LED display is not changed but remains on the normal (x1) value.

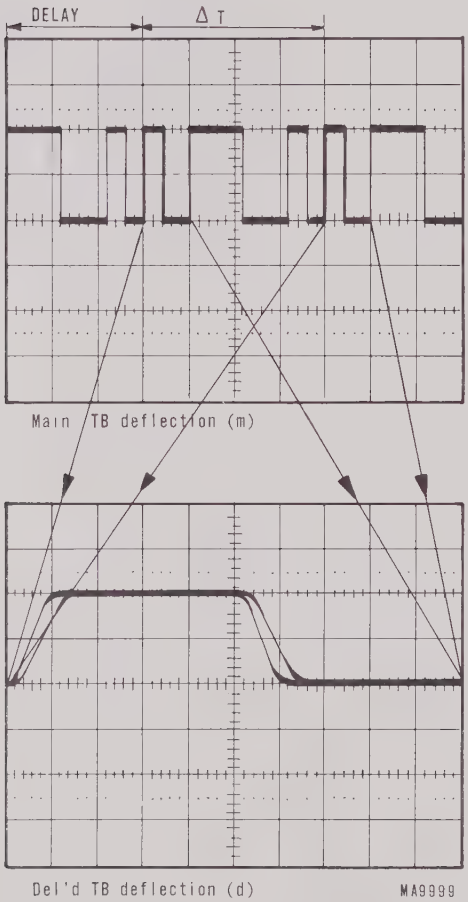
*) *In fact the main time-base ramp voltage is compared with a d.c. voltage derived from the LED display value.*

2.5.2. Delay and ΔT mode

This mode is an extension of the previous DELAY mode. By depressing the ΔT button two delayed time base sweeps are shown on the c.r.t. display during the main time-base sweep*).

Note: At initial selection of the ΔT mode both delayed time-base markers coincide because ΔT value in the memory is zero.





ΔT is the time elapsed between the starting points of the two different delayed time-base sweeps on the c.r.t. display.

The ΔT mode is very suitable for time measurements in complex signals.
The two delayed time-base sweeps are used as markers.

The value of the last selected mode (DELAY or ΔT) is controlled by the SET knob and is shown in the LED display.

By selecting the DEL'D TB deflection (d) both delayed sweeps are shown over the whole c.r.t. display. With the SET knob both delayed sweeps can be controlled to coincide, to obtain the exact ΔT to be shown on the LED display.

Note that to control the DELAY time only the DELAY button must be depressed.
The ΔT can be controlled if the ΔT button has been depressed.

The maximum value of the DELAY time and the ΔT time are each equal to the total maintime base sweep time.

When controlling the time in the ΔT mode it is possible that the DELAY time plus ΔT time exceeds the main time-base sweep time.
However, the ΔT marker does not disappear from the c.r.t. display but stops at the end of the main time-base sweep.
The ΔT time remains stored in the memory so that, if the value of DELAY time is decreased, the ΔT marker starts shifting again at a certain moment.

DIV LED

When the MAIN TB vernier control is not in the CAL position the LED display cannot give the ΔT time value but instead a number of divisions is indicated on the LED display.
In this case the DIV lamp is on and the S or Hz lamp is off.

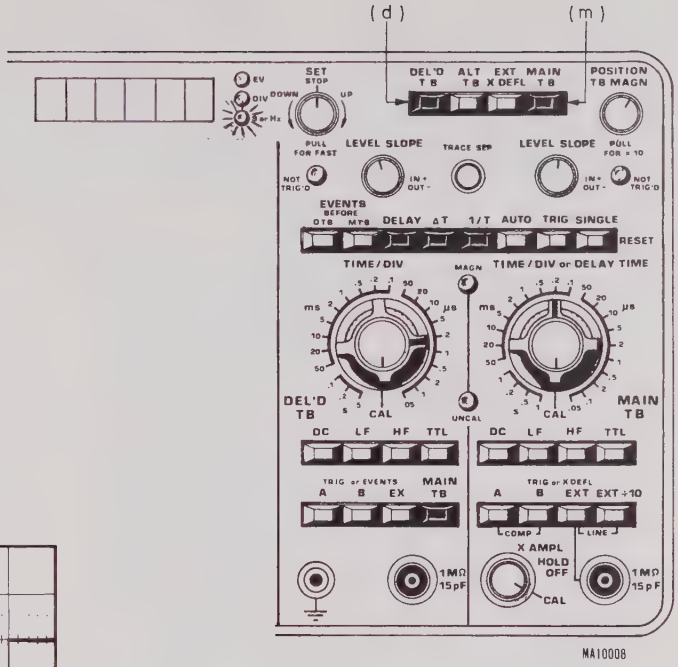
TB MAGN

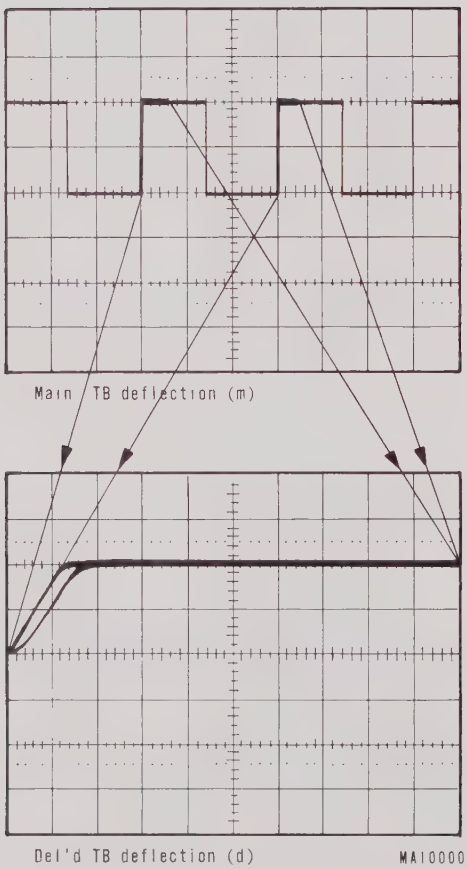
If the TB MAGN is switched on, the LED display is not changed but remains on the normal (x1) value.

*) *In fact the DELAY delayed time-base sweep is written on one main time-base sweep; and the DELAY + ΔT delayed time sweep on the next maintime base sweep and so on.*

2.5.3. 1/T mode

This mode is an extension of the previous ΔT mode, and is used to measure frequency in complex signals.



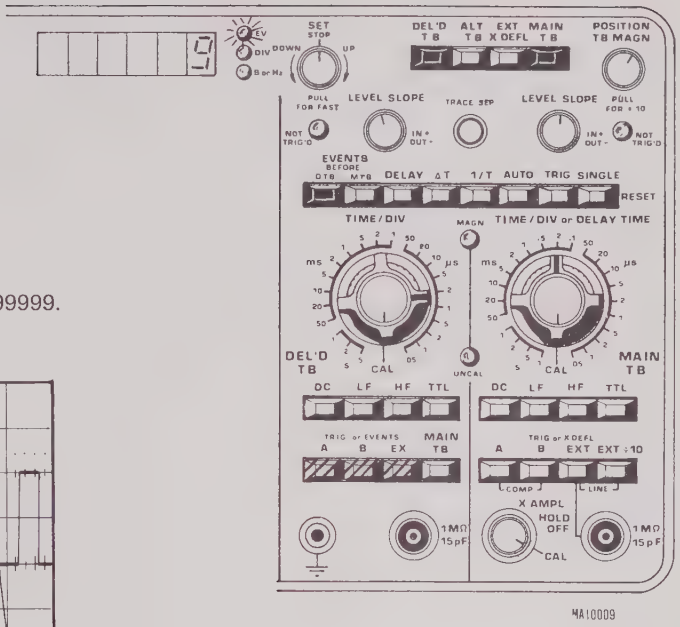


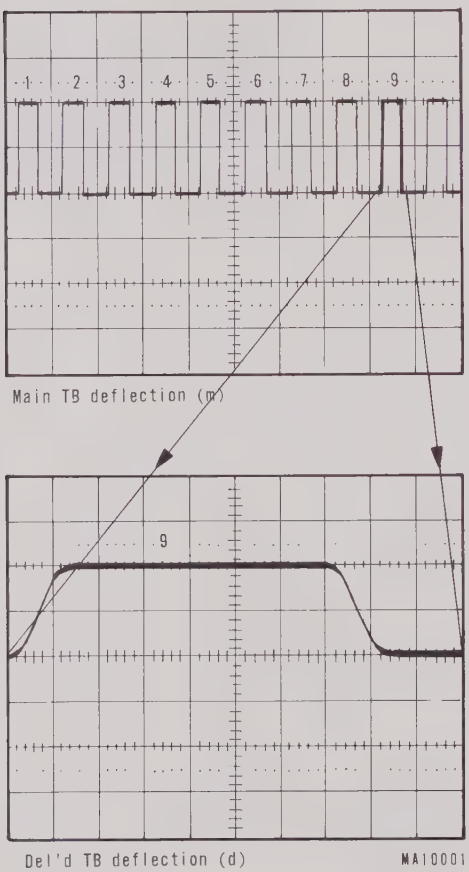
If according to the previous information the DELAY and ΔT are set in such a way that ΔT just encloses one period of the signal, the frequency of that signal is given in the LED display by pushing the 1/T button.

For accurate setting of the markers select the DEL'D TB horizontal deflection and check that both markers coincide.

2.5.4. Events before DTB

In this mode the delayed time-base is triggered after counting a preselected number of events (pulses). The delayed time-base must be triggered (from A, B or EXT). The number of events to be counted is shown in the LED display and can be controlled with the SET knob. Max. amount of events to be counted is 99999.





Note that if the MAIN TB knob of the delayed time-base trigger selector is depressed, the "Error" message is shown on the LED display (because no trigger input is available).

The event counter starts counting at the startmoment of the maintime base sweep.

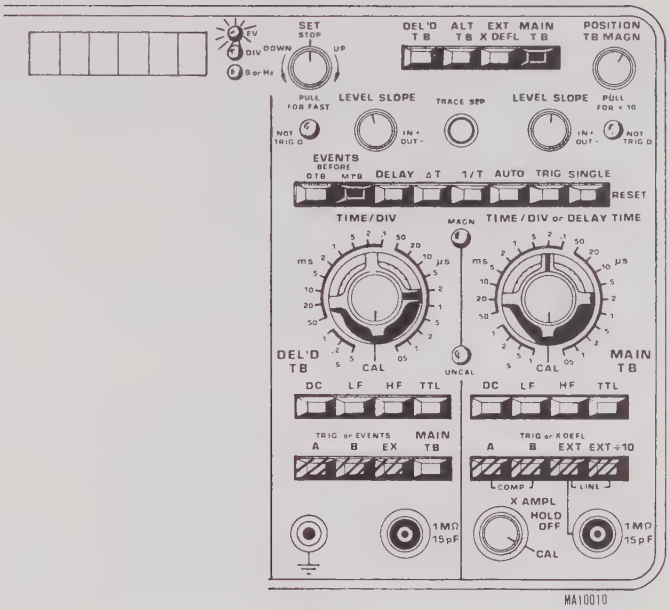
If the delayed time-base NOT TRIG'D lamp remains on, it could be that a higher number of events is selected than are available during one main time base sweep (or trigger control is not set correctly).

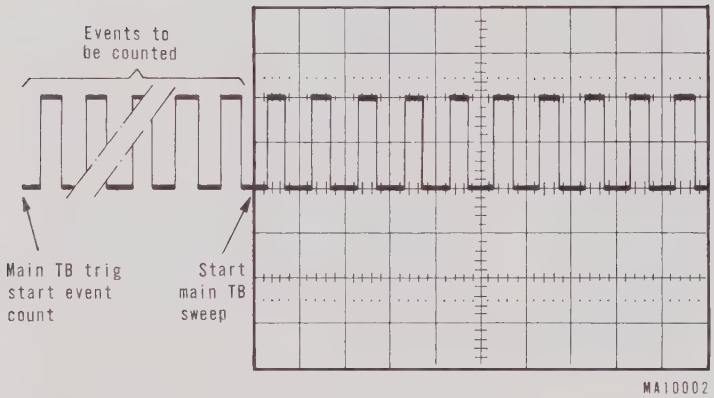
2.5.5. Events before MTB

In this mode the main time-base is triggered after counting a preselected number of events (pulses which are present at the **delayed time-base trigger input** (A, B or EXT.).

The number of events to be counted is shown in the LED display and can be controlled with the SET knob Max. amount of events to be counted is 99999.

The event counter starts counting at arrival of the main time-base trigger pulse; both delayed - and main time-base must be triggered.





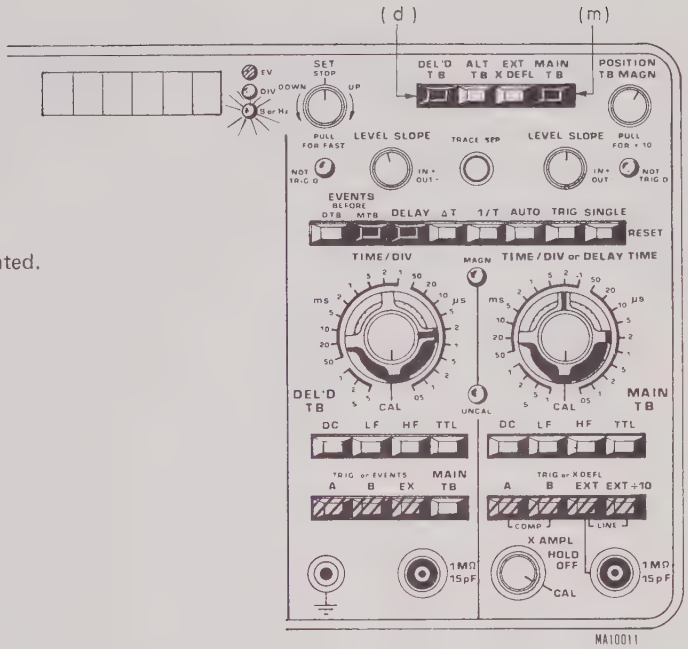
For clear understanding the events to be counted are shown here at the left of the c.r.t. display.

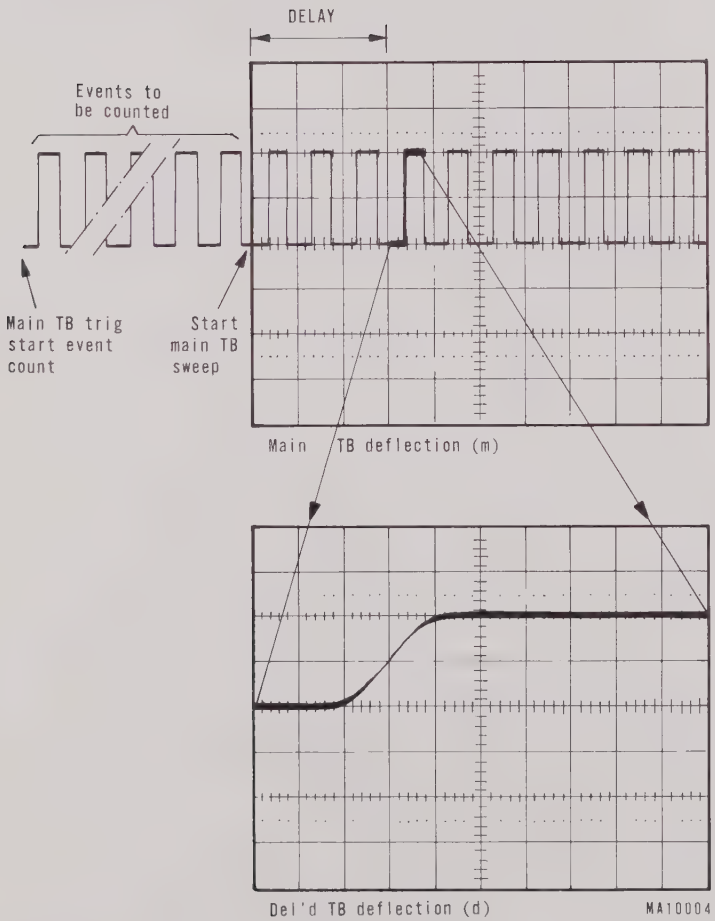
The EVENTS BEFORE MTB mode is very suitable to use in combination with the DELAY, and the ΔT mode.

2.5.6. Events before MTB and DELAY

This is an expansion of the previous mode. The main time-base triggers after counting a preselected number of events (pulses) which are present at the delayed time-base trigger circuit (A, B or EXT).

First press EVENTS BEFORE MTB only and select the number of events to be counted.

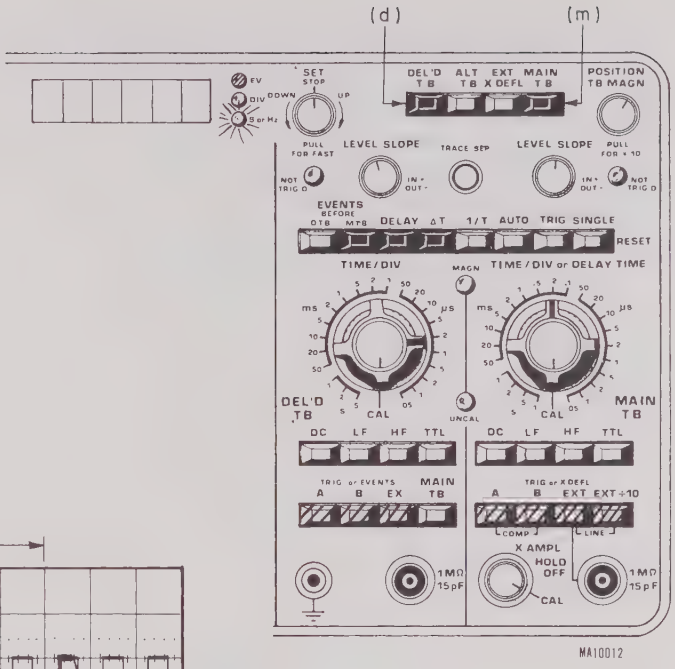


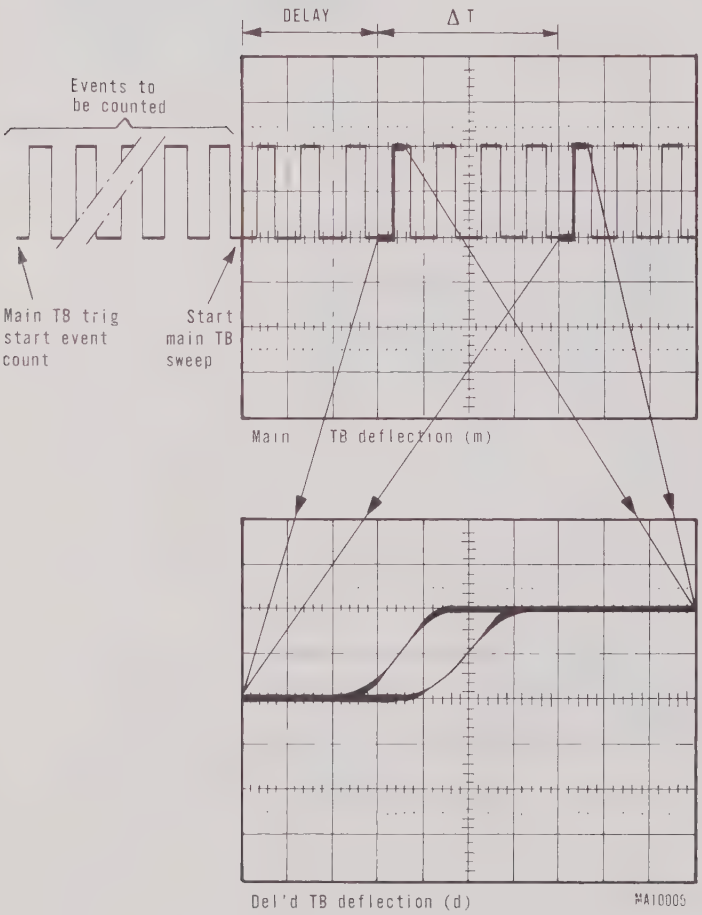


Rotate the DEL'D TB sweep out of the OFF position.
Then press also DELAY and select the delay time.

2.5.7. Events before MTB and DELAY and ΔT

This is a further expansion of the EVENTS BEFORE MTB mode.
The two delayed time base sweeps can be used as markers, ΔT is the time interval between the markers.
The main time-base triggers after counting a preselected number of events which are present at the delayed time-base trigger circuit (A, B or EXT.).
First press EVENTS BEFORE MTB only and select the number of events to be counted.



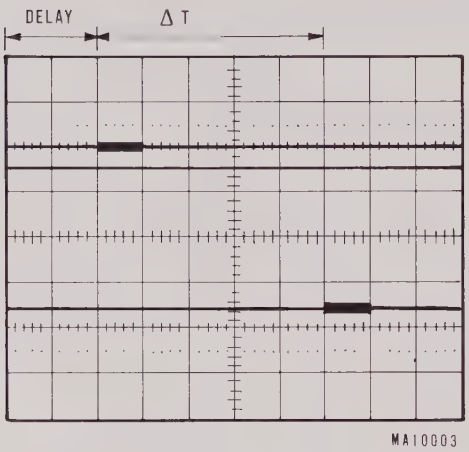


Then press also DELAY and select the delay time (the position of the first marker).
Press also ΔT and select the interval time (the position of the second marker).
For accurate setting of the markers select the DEL'D TB horizontal deflection and check that both markers coincide.

1/T mode can be selected when both markers are located on the same point of two successive cycles.

2.5.8. DELAY and ΔT mode combined with Vertical Alternate Display

If this mode has been selected the A-trace shows only the first delayed time base sweep, and the B-trace shows only the second delayed time-base sweep.



This is a useful mode to measure time between two different parts of two signals.
Both signals must be time-related (e.g. synchronized from the same clock signal).

Connect one signal to ch. A input and the other to the ch. B input.
MTB trigger source may originate from A, B or EXT.
Select both signal-parts by adjusting the DELAY and DELAY + ΔT time.
The time between the starting points of both intensified trace-sections is shown in the LED display.
For accurate setting select the DEL'D TB horizontal deflection.

2.5.9. LED display with SET control

This display contains 6 digits and is on, when:

1° EVENTS BEFORE MTB is selected

or

2° DTB TIME/DIV knob is out of the OFF position, and:

EVENTS BEFORE DTB
or DELAY } is selected
or ΔT

Independent of the above conditions the display is on:

- during the power-on test, at the moment that the oscilloscope is switched on
- in the self-test mode (refer to the Service section of this manual).

The LED display shows:

- A number of events (pulses) in the EVENTS BEFORE DTB or MTB mode; the EV lamp is on.
  With the SET control every number between 1 and 99999 can be selected.
- A time duration in the DELAY or ΔT mode.
  This time is indicated in a mantissa with a ten's exponent (engineering notation).
  The maximum indicated time in the display is equal to the full sweep time of the main time-base.
- A frequency (in 1/T mode) indicated in a mantissa and a ten's exponent (engineering notation).

Other display possibilities:

TB OFF

Indicates that for horizontal deflection the EXT X DEFL has been selected, and the instrument is in the event count, delay or ΔT mode.

ERROR[*)]

Indicates that in the EVENTS mode the MTB trigger source of the DTB triggering has been selected.
Press A, B or EXT of the DTB triggering.

UNCAL[*)]

The display can indicate the word UNCAL together with a number 1, 2 or 3.
The UNCAL display is for the convenience of the operator, to indicate that no calibrated measurement can be made.

UNCAL 1 — Means that in the DELAY or ΔT mode A, B or EXT source for DTB triggering has been chosen. Press MTB trigger source of the DTB triggering.

UNCAL 2 — Indicates that in the 1/T mode the distance between the markers is smaller than 0,1 DIV; the value in the display is then no longer accurate.
Take a shorter MTB sweep setting, or increase the time with the SET knob.

UNCAL 3 — Indicates that in the 1/T mode the MTB sweep control is not in the CAL position (frequency calculation not possible).

Lamp EV

Is on if the display shows a number of events to be counted.

Lamp DIV

Is on if the DELAY or ΔT mode the MAIN TB sweep continuous control is not in the CAL position.
The LED display shows now no longer a time, but a number of c.r.t. divisions instead.
The S or Hz lamp is then extinguished.

Lamp S or Hz

Is on in the DELAY, or ΔT, or 1/T mode.

SET

This knob permits control of the delay time(s) in the DELAY TIME or ΔT mode; and the number of events to be counted in the EVENTS BEFORE DTB or - BEFORE MTB modes.
Any operation of this knob influences directly the data on the LED display.

In the centre position (STOP) of this knob the LED display data remains unchanged.
Turning the knob to the right increases, and turning to the left decreases the value on the LED display. The more the knob is turned from the centre the higher the changing rate on the LED display.
The change rate is increased with a factor of 100 by depressing the SET knob.

*) *The ERROR and UNCAL explanation is also given in the carrying handle.*

Bedienungsanleitung

1. ALLGEMEINES

1.1. EINLEITUNG

Das PM 3263 ist ein tragbares Zweikanal-Breitbandoszilloskop, hoher Empfindlichkeit mit mikroprozessorgesteuerten Zeitmesseinrichtungen.
Diese Einrichtungen umfassen:

- Zweifach verzögerte Zeitbasis
- Ereigniszähltriggerung für sowohl Hauptzeitbasis wie verzögerte Zeitbasis
- Frequenzmessungen

Die Ergebnisse der Zeit- und Frequenzmessungen und die gewählte Anzahl der zu zählenden Ereignisse werden in einer 6-stelligen LED-Anzeige dargestellt.
Bei Bedienungsfehlern signaliert die LED-Anzeige eine ERROR oder UNCAL Warnung.
Weitere Möglichkeiten sind: Darstellung des Triggersignals (Trigger view), alternierende Darstellung der Zeitbasis und TTL-Triggerung.
In alternierender Betriebsart kann ein Signal gleichzeitig auf zwei verschiedenen Zeitbasis-Masstäben, die von Hauptzeitbasis und verzögerter Zeitbasis zur Verfügung gestellt werden, dargestellt werden.
Die zahlreichen integrierten Schaltungen mit denen das Oszilloskop bestückt ist gewährleisten einen stabilen Betrieb und verringern die Anzahl der Einstellpunkte.
Die Versorgungsspannung lässt sich mit Hilfe eines Schalters für zwei Bereiche, nämlich 90 V bis 140 V und 180 V bis 265 V einstellen.
Durch die vielseitigen Eingenschaften ist das Oszilloskop für einen ausgedehnten Anwendungsbereich geeignet.

MAT 196

Frontansicht PM 3263

1.2. TECHNISCHE DATEN

Allgemeine Hinweise:

Dieses Gerät ist gemäss IEC 348, Sicherheitsbestimmungen für elektrische Mess- und Regeleinrichtungen, gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreien Zustand verlassen. Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muss der Anwender die Hinweise und Warnvermerke beachten, die in dem vorliegenden Gerätehandbuch enthalten sind.
Nur Angaben mit Toleranzen oder Grenzwerten können als garantierte Daten angesehen werden. Daten ohne Toleranzen, d.h. ohne Fehlergrenzen, sind informative Daten und werden nicht garantiert.
Die Daten gelten nach einer Anwärmzeit von 30 minuten nach dem Einschalten.
Prozentuale und absolute Fehler sind auf den jeweils angegebenen Referenzwert bezogen.

Benennung	Beschreibung	Nähere Angaben
1.2.1. Elektronenstrahlröhre		
– Type	PHILIPS D14-300GH/37	Rechteckiger Schirm, mit Netzelektrode und Nachbeschleunigung, metallhinterlegter Leuchtschirm.
Ausnutzbare Schirmfläche	80 mm x 100 mm	
– Schirmtyp	P31 (GH) Phosphor	P7 (GM) Phosphor auf Wunsch lieferbar, auch P11 (BE)
Photografische Schreibe Geschwindigkeit	> 1500 cm/μs	Typisch 2000 cm/μs. Gemessen mit Steinheil Oscillophot M5 Kamera. Blende: 1:1,2 Bildausschnitt Verhältnis: 1:0,5 Film: Polaroid 410 (10.000 ASA) Keine Vorbelichtung Phosphor Typ P31 (GH).
Gesamte Beschleunigungsspannung	17 kV	
Raster	Intern	Stufenlos einstellbare Rasterbeleuchtung
Einteilung	Zentimetereinstellung mit Untereinteilung von 2 mm an den mittleren Achsen. Gestrichelte Linien bei 1,5 und 6,5 Teilen vom oberen Ende der Anzeige ergeben einen Messraster zum Messen von Anstiegszeiten.	
– Bilddrehung	Schraubenziehereinstellung an Frontplatte.	(Trace Rot.)
1.2.2. Vertikale oder Y-Achse		
– Kennlinie (2 mV Bereich ausgenommen)		
Frequenzbereich	DC ... 100 MHz AC 10 Hz .. 100 MHz	–3 dB obere Bandbreitengrenze –3 dB Der Frequenzbereich beinhaltet einen 10:1 Messkopf über 20 - 30 °C.
Anstiegzeit	3,5 ns	
Überschwingen	± 3 % Spitze-Spitze	Uber 6 Teile, + 5 – +40 °C
(Für Kenndaten des 2 mV-Bereichs siehe am Ende dieses Abschnitts)		

Benennung	Beschreibung	Nähere Angaben
– Ablenkkoeffizient	2 mV/Teil ... 5 V/Teil	Elf, kalibrierte Stellungen, Folge 1-2-5. Nicht kalibriert stufenlos einstellbar 1:⩾2,5. Nicht kalibrierte Lampenanzeige.
Fehlergrenze	± 3 %	
– Hochstzulässige Eingangs-spannung	± 400 V	Gleichspannung - Spitzenwert einer Wechselspannung. Minderung bei Frequenzen über 500 kHz. Siehe Abb. 1.3.
Maximale unverzerrte Ablenkung	24 Teile	Bis 35 MHz
Verschiebungsbereich	16 Teile	Je 8 Teile über und unter der mittleren Rasterlinie.
– Eingangsimpedanz	1 MOhm ± 2 %//ca. 15 pF	Eingang A und B gleich eingestellt.
Zeitkonstante der Eingangs-schaltung	22 ms	AC Eingangskopplung
Bildstabilität	0,1 Teil/Stunde	Temperaturbereich +20 - +40 °C.
Bildsprung	0,2 Teil	Beim Schalten zwischen einer der Stellungen des Abschwächers.
Bildsprung	0,5 Teil	Beim Schalten des NORM/INVERT Schalters
Bildverschiebung	0,2 Teil	Beim Drehen des kontinuierlichen Abschwächers 0,4 Teil in 5 mV Stellung
Bildverschiebung	1 Teil	Beim Eindrücken der Taste ADDED 0,4 Teil in 5 mV Stellung. Ansteigend beim Drehen des stufen-losen Abschwächers.
Langzeit-Temperaturdrift	20 µV/°C	Typischer Wert gemessen bei 2 mV über 4 Teile.
– Sichtbare Signalverzögerung	ca. 15 ns	
– Darstellungsarten	Kanal + oder – A allein Kanal + oder – B allein Darstellung des Triggersignals allein Kanäle ± A und ± B gechopped Kanäle ± A und ± B alternierend Kanäle ± A und ± B addiert Triggersignalbild ± A und ± B gechopped oder alternierend (3-Kanal Anzeige)	
		Wenn die Triggersignal-Darstellung zu-sammen mit alternierender Zeitablenk-darstellung gewählt ist, erfolgt die Anzeige automatisch in aufgehellter Zeitablenkungsart. Siehe auch Abb. 1.5. "Übersicht der verschiedene Darstellungs-arte mit doppelte verzögerte Zeitbasis."
– Chopperfrequenz	1 MHz	Anzeigedauer pro Kanal ca. 350 ns.
– Übersprechen zwischen Kanälen	1:500	Bis 50 MHz
– Gleichtaktunter drückung	Besser als 100 bis 2 MHz 20 bei 50 MHz.	Gemessen bei +A und –B addiert. Max. Gleichtaktsignal 8 Teile.

Benennung	Beschreibung	Nähere Angaben
– Triggersignaldarstellung		
Anzeige	Externes oder internes Triggersignal	
Frequenzgang	⩾ 80 MHz	
Ablenkkoeffizient	Gleich an vertikal	
Extern	100 mV/Teil ± 3 %	
Extern : 10	1 V/Teil ± 5 %	
Intern	Vertikal ± 10 %	
Triggerpunkt (Schwelle)	Schirmmitte ± 0,3 Teil	Gleichspannungskopplung
Überschwingen	± 10 % Spitze-Spitze	
Verzögerungszeit zwischen Vertikal-eingang und externem-Eingang	3 ns ± 1 ns	
– Kenndaten für die 2 mV/Teil Einstellung		
Ablenkkoeffizient	2 mV/Teil	
Fehlergrenze	± 5 %	
Frequenzbereich	DC 0 - 35 mHz AC 7 Hz - 35 MHz	–3 dB obere Bandbreitengrenze –3 dB
Anstiegzeit	10 ns	
Uberschwingen	± 5 % Spitze-Spitze	
Gleichtaktunterdrückung	Besser als 100 bis 2 MHz	
Instabilität		
Bildstabilität	0,25 Teil/Stunde	+20 - +40 °C Temperaturbereich
Bildsprung	1 Teil	Beim Schalten zwischen 2 mV/Teil und 5 mV/Teil
Bildsprung	2 Teile	Bei Betätigung des Schalters NORM/INVERT
Bildverschiebung	1 Teil	Beim Drehen des kontinuierlichen Abschwächers
Bildverschiebung	1 Teil	Beim Schalten auf Stellung ADDED.

1.2.3. Horizontale oder X-Achse

– Darstellungsmöglichkeiten	– Hauptzeitbasis	
	– Hauptzeitbasis aufgehellt durch verzögerte Zeitbasis	
	– Verzögerte Zeitbasis	
	– Hauptzeitbasis aufgehellt und verzögerte Zeitbasis alternierend dargestellt.	Leuchtspurentrennung von 4 Teilen möglich
	– X-Y und X-Y/Y Betrieb	X-Ablenkung durch: – Kanal A Signal – Kanal B Signal – Signal über EXT Anschluss der Hauptzeitbasis – Netzspannung

Doppelte verzögerte Zeitbasis und Ereigniszählung siehe: 1.2.6.

Benennung	Beschreibung	Nähere Angaben
– Horizontaldrift in x1 Stellung	0,2 Teile/Stunde	Die Horizontaldrift bei x1 Dehnung darf 0,1 Teil/Std. über +20 - +40 °C Temperaturbereich. Die gleichen Stabilitätsbedingungen gelten für den Start der Ablenkung bei Änderungen der Ablenkgeschwindigkeitseinstellung, ausgenommen sind die höchsten Ablenkbereiche (50-100 ns/Teil).
– Horizontal-Einstellung	± 5,2 Teile von Schirmmitte	Der Steller für die Horizontalverschiebung umfasst Grob- und Feineinstellung.

1.2.4. Hauptzeitbasis

– Betriebsart	Automatisch	Automatischer Freilauf bei Abwesenheit von Triggersignalen nach weniger als 0,1 s.
	Getriggert	
	Einmalig	
Ablenkzeitkoeffizient	1 s/Teil ... 50 ns/Teil	In 23 Kalibrierten Stufen, Folge 1-2-5. Dazwischen stufenlos einstellbar 1:⩾ 2,5 nicht kalibriert. Eine Lampe UNCAL (nicht kalibriert) für sowohl Hauptzeitbasis wie verzögerte Zeitbasis (MTB und DTB).
– Fehlergrenze des Zeitmassstabes	± 2 % ± 3 %	+20 °C ... +30 °C + 5 °C ... +40 °C Die Differenz in Ablenkgenauigkeit über beliebige 2 Teile von 10-Teil-Zeitablenkung ist ± 5 %. Die ersten und letzten Teile der 5 ns und 10 ns gedehnten Zeitablenkung sind auszuschliessen.
– Regelbare Sperrzeit (''Hold-off'')	Die Sperrzeit der Zeitablenkung kann bis zum Faktor 10 vergrössert werden.	Die Sperrzeit ist minimal in CAL position. Kombiniert mit X Ampl. Regler.
– Dehnung	10x	Geschaltet, kalibriert. Der Bildteil der mit der mittleren horizontalen Rasterlinie zusammenfällt darf beim Ändern der horizontalen Dehnung von x1 auf x10 um nicht mehr als 1 Teil verschieben.
Koeffizientfehler	± 1 % zusätzlich	± 5 % bei den ersten und letzten 50 ns von 5 ns/Teil, 10 ns/Teil und 20 ns/Teil der gedehnten Zeitablenkung.
Kürzester Zeitmasstab	5 ns/Teil	

1.2.5. Verzögerte Zeitbasis

– Betrieb	Normal	Gestartet von MAIN TB oder getriggert.
	Doppel	Gestarted von MAIN TB.

Benennung	Beschreibung	Nähere Angaben
– Zeitmasstäbe	0,5 s/Teil ... 50 ns/Teil	In 22 kalibrierten Stufen (Folge 1-2-5). Dazwischen stufenlos einstellbar 1:⩾2,5 nicht kalibriert. Eine Lampe UNCAL (nichtkalibriert) für sowohl Hauptzeitablenkung wie verzögerte Zeitablenkung (MTB und DTB).
Fehlergrenze des Zeitmass-stabes	± 2 % ± 3 %	+20 °C ... +30 °C + 5 °C ... +40 °C Die Differenz in Zeitablenkungs-Genauigkeit für zwei beliebige Teile von 10-Teil-Zeitablenkung ist ± 5 %. Die ersten und letzten Teile der 5 ns und 10 ns gedehnten Zeitablenkung sind auszuschliessen.
– Dehnung	Gleich wie beim Hauptzeitbasis	

1.2.6. Verzögerungsarten

– Verzögerung	Verzögerte Zeitbasis startet sofort nach Verzögerungszeit	LED zeigt Verzögerungszeit an.
oder	Verzögerte Zeitbasis triggert nach Verzögerungszeit.	LED zeigt UNCAL 1
– ΔT	Verzögerte Zeitbasis startet sofort nach der 1. und 2. Verzögerung.	LED zeigt Verzögerungszeitintervall an.
1/T	Intervall oder Verzögerungs-zeit invertiert.	LED zeigt den Frequenz des Signals falls ΔT or Delay-time eine Periode des Signals umfasst.
– Ereignisse vor DTB	Verzögerte Zeitbasis wird nach Zählung einer gewissen Anzahl von ereignissen getriggert.	LED zeigt die gewählte Anzahl von Ereignissen an.
– Ereignisse vor MTB	Die Hauptzeitbasis wird nach Zählung einer gewissen Anzahl von Ereignissen getriggert.	LED zeigt die gewählte Anzahl von Ereignissen an.
– Ereignisse vor MTB kombiniert mit Verzögerung, ΔT oder 1/T	Die Hauptzeitbasis wird nach einer gewissen Anzahl von Ereignissen getriggert.	Die Led zeigt den Wert der zuletzt gewählten Funktion an vorherige Funktionen und Werte werden gespeichert. Triggerung der verzögerten Zeitbasis nicht möglich.
Verzögerung, ΔT oder 1/T	Einstellbar zwischen 0x und 10x der Zeitkoeffizient der Hauptzeitbasis.	LED zeigt 4 (oder 3) Stellen mit Exponent an. Verzögerung wird in Sekunden angegeben oder falls der stufenlose MTB Steller nicht auf CAL steht in DIV. Wenn DTB getriggert wird zeigt die LED UNCAL 1 an.
Auflösung	5.10^{-4} von 10X MTB-Einstellung	Wenn der stufenlose MTB-Einsteller auf CAL steht. Wenn der stufenlose MTB-Einsteller nicht auf CAL steht 0,05 mm.

Benennung	Beschreibung	Nähere Angaben
Ereignisse vor DTB	Anzahl der Ereignisse zwischen 0 und 99999 einstellbar.	Die Anzahl der Ereignisse ist mit Hilfe des Potentiometers SET kontinuierlich einstellbar. Die Anzeigezählgeschwindigkeit ist proportional dem Drehungswinkel des Potentiometers und regelbar zwischen 1 und 50 Impulsen pro Sekunde; in gezogener Stellung zwischen 100 und 5000 Impulsen pro Sekunde. Wenn die mit dem Potentiometer eingestellte Impulsanzahl grösser ist als die bei einer MTB-Ablenkung angezeigte Anzahl von Impulsen, dann wird die Lampe NOT TRIG aufleuchten. Wenn beim Ereigniszählbetrieb Triggerquelle MAIN TB gewählt ist, dann wird dies von der LED mit ERROR angezeigt.
Ereignisse vor MTB	Anzahl der Ereignisse zwischen 0 und 99999 einstellbar.	MTB-Trigger started den Ereigniszähler; und die Ereignisse werden vom DTB Triggerschaltung behandelt.
	Ereignisse vor MTB kann kombiniert werden mit Delay, ΔT oder 1/T.	
Impuslbedingungen	Max. Ereignisfrequenz 125 MHz. Min. Impulsbreite 4 ns Min. Impulsabstand 4 ns	
Anlaufzeit	Siehe Abb. 1.2.	

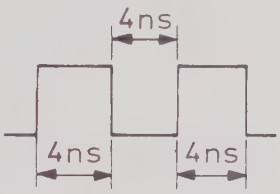


Fig. 1.1. Max. Ereignissfrequenz 125 MHz.

1.2.7. X-Ablenkung über Kanal Y_A oder Y_B

– Ablenkkoeffizient	2 mV/Teil ... 5 V/Teil	Nichtkalibrierte stufenlose Einstellung 1:⩾ 2,5.
Koeffizientfehler	± 5 %	
Bandbreite	0-2 MHz	–3 dB Bandbreite über 8 Teile
Maximale unverzerrte Ablenkung	20 Teile	bis zu 0,1 MHz
Phasenverschiebung bezogen auf Y-Darstellung	3^{o} bei 0,1 MHz	

1.2.8. Externe X-Ablenkung über Buchse EXT

– Ablenkkoeffizient		
Extern	50 mV/Teil	Nichtkalibrierte stufenlose Einstellung
Extern ÷ 10	500 mV/Teil	1:3 mittels Steller X AMPL. Kalibriert im ganz nach rechts gedrehter Stellung (CAL).
Eingangscharakteristiken	Gleiche Werte wie Y-Kanäle	
Genauigkeit	± 3 %	Zusätzlich 2 % für Ext. ÷ 10.
Bandbreite	DC ... 2 MHz 7 Hz ... 2 MHz	Über DC Triggerkopplung Über NF oder HF Triggerkopplung.
Phasenverschiebung bezogen auf Y-Kanäle	3^{o} bei 0,1 MHz	
Linearität	1,5 %	
Drift	0,2 Teil/Stunde	

Benennung	Beschreibung	Nähere Angaben

1.2.9. Triggerung der Hauptzeitbasis

Triggerquelle	Intern von Kanal A Intern von Kanal B Zusammengesetzt A und B (COMP.) Intern von Netz Extern Extern ÷ 10	Nur Betriebsart vertikal alternierend.
Betriebsart	Automatische Triggerung	Automatischer Freilauf des Zeitablenkgenerators etwa 0,1 s nach Verschwinden des Triggersignals.
	Trigger	
	Einmaliger Ablauf der Zeitablenkung	
Lampe NOT TRIG'D	Zeigt den nicht getriggerten Zustand der Hauptzeitbasis an. Bei einmaligen Ablauf der Zeitablenkung leuchtet die Lampe nach Rückstellung der Hauptzeitbasis und erlischt nach Ablauf der Ablenkung.	
Flanke	+ oder –	
Triggerempfindlichkeit	Intern, besser als: 0,5 Teil bis 30 MHz 1,5 Teil bis 100 MHz 2 Teile bis 150 MHz	Typischer Wert, frequenzabhängig siehe Abb. 1.4.
	Extern: 50 mV bis 30 MHz 150 mV bis 100 MHz 200 mV bis 150 MHz	
	Extern ÷ 10: Typisch 10x höhere Werte als in Stellung EXT.	
Triggerarten und Kopplung	DC ganze Bandbreite NF int.: 0 - 30 kHz NF ext.: 7 Hz - 30 kHz HF: 30 kHz - 100 MHz TTL Automatische triggerung	Intern und Extern –3 dB –3 dB –3 dB, intern und extern Pegelbereichsteller wird abgeschaltet.
TTL-Pegel	Interne Triggerung (A, B oder COMP.) Niedrig : 0,8 Teil (± 0,4 Teil) Hoch : 2 Teile (± 0,4 Teil) Lücke : 1,2 Teil	
	Externe Triggerung Niedrig : 0,8 V (± 0,4 V) Hoch : +2 V (± 0,4 V) Lücke : 1,2 V	Diese Daten gelten für Spannungen an der Spitze eines 1:10 Abschwächer-Tastkops angeschlossen an Eingangsbuchse EXT und mit dem Triggerquellen-Wahlschalter in Stellung EXT.
Pegelbereich	Interne Triggerung: 24 Teile Externe Triggerung: +1,2 V bis –1,2 V Extern ÷ 10: +12 V bis –12 V	
Eingangsimpedanz	Gleiche Wert wie Y-Kanäle	
Triggerjitter	Besser als 0,5 ns	

Benennung	Beschreibung	Nähere Angaben
1.2.10. Triggerung der verzögerten Zeitbasis		
Triggerquelle	Intern von Kanal A Intern von Kanal B Extern Haupzeit basis	Die übrigen Kenndaten sind die gleichen wie bei TRIGGERUNG DER HAUPTZEITBASIS, ausgenommen EXT ÷ 10 und Netztriggerung.
Lampe NOT TRIG'D	Zeigt den nicht getriggerten Zustand der verzögerten Zeitbasis an.	
1.2.11. Kalibrierungsausgang		
Spannung	3 V_{SS}	
Strom	6 mA	Durch Schleife
Fehlergrenze	± 1 %	Spannung und Strom
Frequenz	2 kHz ± 2 %	
Sicherung	Der Ausgang ist gegen Dauerkurz-Schlüsse gesichert.	
1.2.12. Zusätzliche Ein- und Ausgänge		
Z-Modulation	Gleichspannungsgekoppelt TTL-kompatibel Ansprechzeit 35 ns Eingangsimpedanz 10 kΩ Max. Eingangsspannung 50 V	Hoher Pegel verdunkelt das Bild.
Hauptzeitbasistorausgang	Während Ablenkung +5 V normal "0" V.	Ausgangsimpedanz 1 kΩ
Verzögerten Zeitbasistor-ausgang	Während Ablenkung +5 V normal "0" V.	Ausgangsimpedanz 1 kΩ
1.2.13. Speisung		
Netzspannungen	AC 100 - 127 V ± 10 % AC 220 - 240 V ± 10 % DC 250 - 350 V	Automatisch gegen falsche Einstellung des Netzwahlschalters geschützt. Die Stellung des Netzwahlschalters ist bei Gleichspannung balanglos.
Netzfrequenz	46 bis 440 Hz	
Leistungsaufnahme	60 W	
Eingebaute Netzsicherung	2A, träge	An der Rückwand des Geräts
Sprunghafte Netzänderungen		Bei Auftreten von sprunghaften Spannung- und Frequenzänderung wie gegeben in den MIL-T-28800 Vorschriften wird das Gerät keinen Schaden erleiden.

Benennung	Beschreibung	Nähere Angaben

1.2.14. Einflussgrössen

Die angegeben Daten gelten nur dann, wenn das Gerät gemäss den offizielen Prüfverfahren kontrolliert wurde. Einzelheiten, die dieses Verfahren und die Fehlergrenzenkriterien betreffen, können von der PHILIPS-Organisation Ihres Landes oder von N.V. PHILIPS'GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPT., EINDHOVEN, HOLLAND angefordert werden.

– *Temperaturprüfungen*

Den IEC 68 Ab und Bb entsprechend.
Arbeitsbereich: –15 °C ... +55 °C
Betrieb innerhalb Spezifikation: +5 °C ... +40 °C. Ausgenommen die jeweils pro Spezifikationen angegebenen Toleranzen.
Lagerung: –55 °C ... +75 °C.

– *Höhe*

Nach Vorschriften IEC 68-2-13, Test M.
Arbeitshöhe: bis 5000 m
Minderung: 1 °C/300 m für die max. Arbeitstemp.
Lagerung: bis 17.000 m.

– *Luftfeuchte*

Entsprechend IEC 68 Db, anhand des Philips Oszilloskop Standard Testprogramms geprüft, auch verglichen mit MIL-E-1640F 5 Zyklen (120 Stunden).

– *Stossbelastung*

In Betrieb; 30 g, 1/2 Sinus, Dauer 11 ms, 2 Stösse pro Achse pro Richtung bei insgesamt 12 Stössen.

– *Vibration*

In Betrieb: 15 Minuten entlang jeder der 3 Achsen.
0,6 mm (0,025 inch) Spitze-Spitze Verlagerung (4 g bei 55 Hz) bei einer Frequenz variierend von 10 Hz nach 55 Hz in Zyklen von einer Minute.

– *Erholzeit*

Das Gerät arbeitet innerhalb von 30 min. wenn es von –10 °C auf +20 °C bei 60% relativer Luftfeuchtigkeit erwärmt wird.

– *Magnetische Abschirmung*

Nach IEC 351 - 22.3.1.
Maximale Abweichung 1 Teil.

– *Störgrad*

Den Vorschriften VDE 0871 und 0875, Störgrad K entsprechend.

1.2.15. Mechanische Daten

Abmessungen	Länge	460 mm	Ohne Bedienungsorgane, Deckel und Füsse.
	Breite	316 mm	
	Höhe	154 mm	
Gewicht	10,7 kg.		

1.3. ZUBEHÖR

1.3.1. Mit dem Gerät gelieferten Zubehör

- Zwei passive 10:1 Tastköpfe
- Kontrastfilterscheibe
- Abdeckhaube mit Aufbewahrungsraum
- Faltbarer Lichtschutztubus PM 9366
- BNC Übergangsstecker PM 9051
- CAL Anschlussklemme - BNC Adapter
- Anleitung

1.3.2. Wahlzubehör

PM 8921	Passiver Tastkopfsatz 1 : 1 (1,5 m)
PM 8921L	Passiver Tastkopfsatz 1 : 1 (2,5 m)
PM 8935	HF passiver Tastkopfsatz 10 : 1 (1,5 m)
PM 8935L	HF passiver Tastkopfsatz 10 : 1 (1,2 m)
PM 8932	Passiver Tastkopfsatz 100 : 1
PM 8940	Isolierte Verstärker
PM 8943	Fet Tastkopf 1 : 1, 10 : 1, 100 : 1
PM 8994	Satz Tastkopfzubehören
PM 9355	Stomzange: 1 mA/Teil ... 1 A/Teil 12 Hz ... 70 MHz
PM 9346	Stromversorgung für aktive Tastköpfe
PM 8960	19'' Gestelleinbausatz
PM 8992	Zubehörtasche
PM 9380	Oszillografenkamera
PM 8971	Adapter für Oszillografenkamere
PM 8910	Polaroid Anti-Reflex Filter
PM 8980	Langer Einblicktubus
PM 8901	Batteriespeisung 24 V und 280 V Gleichspannung
PM 8991	Rollwagen

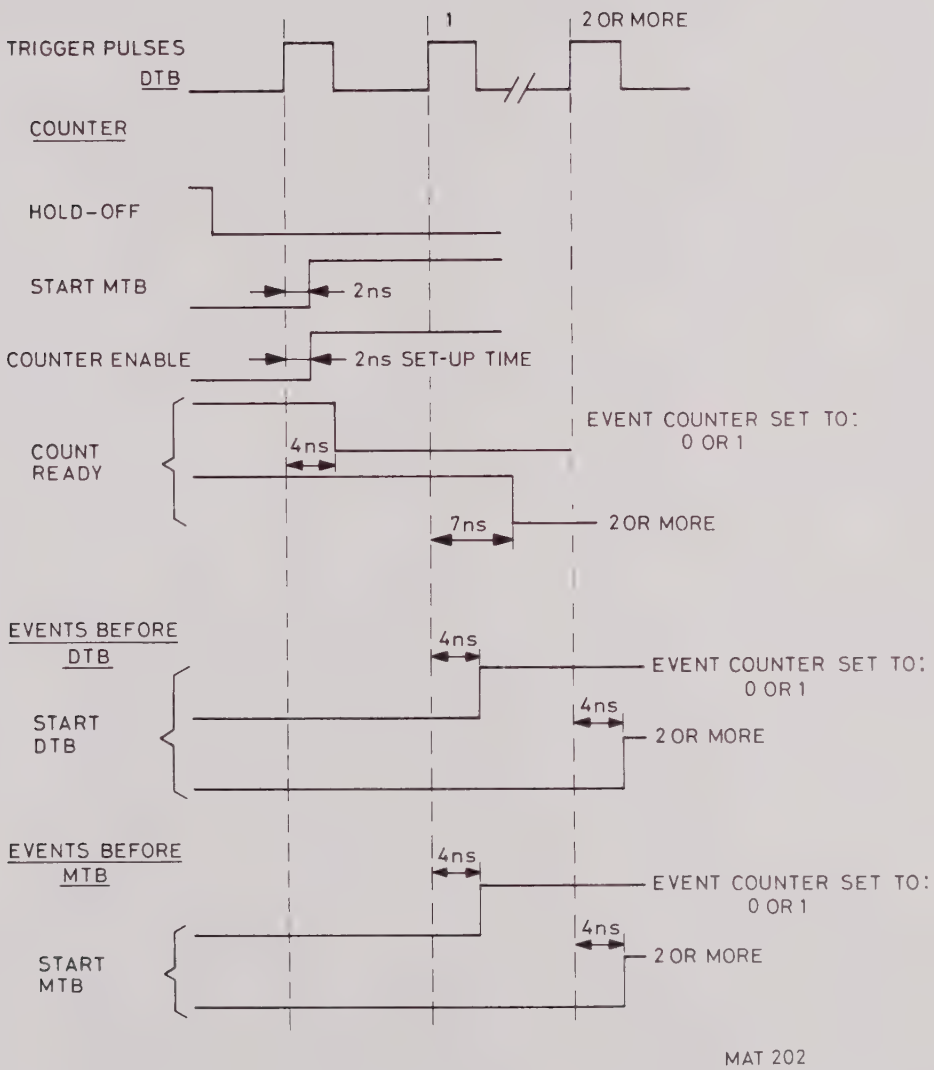


Abb. 1.2. Anlaufzeit

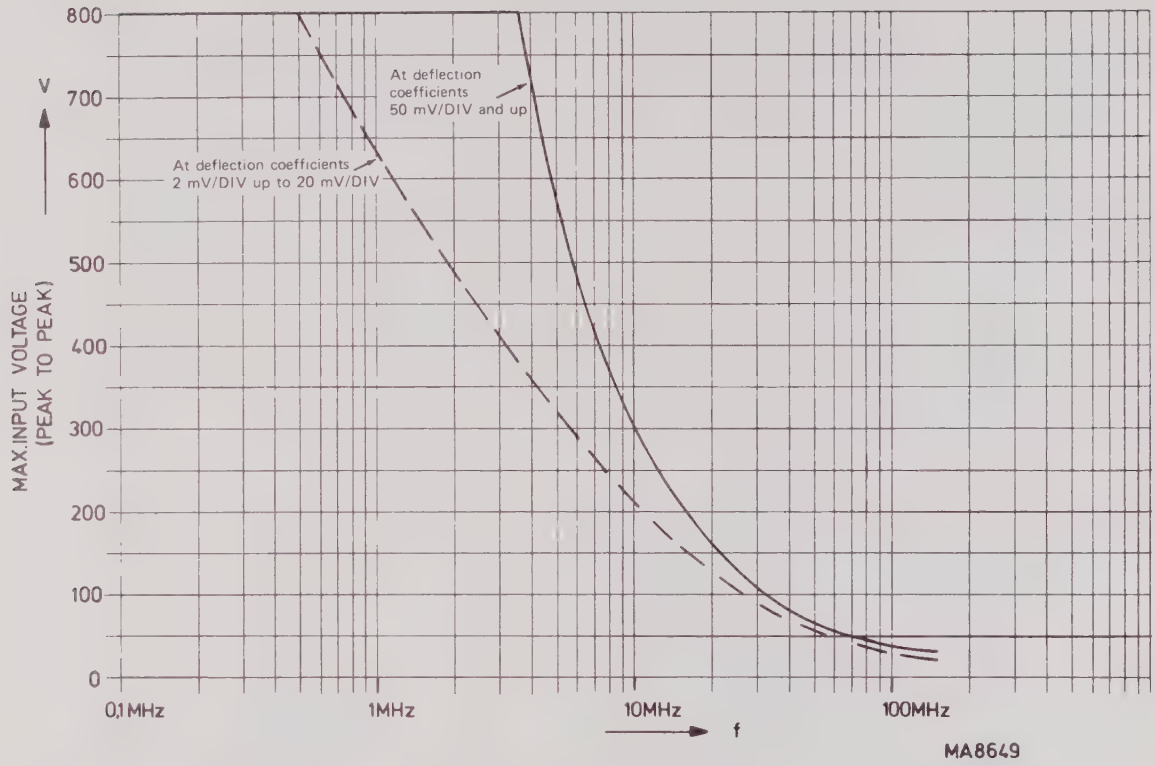


Abb. 1.3. Frequenzabhängige Minderung der höchstzulässige Eingangsspannung.

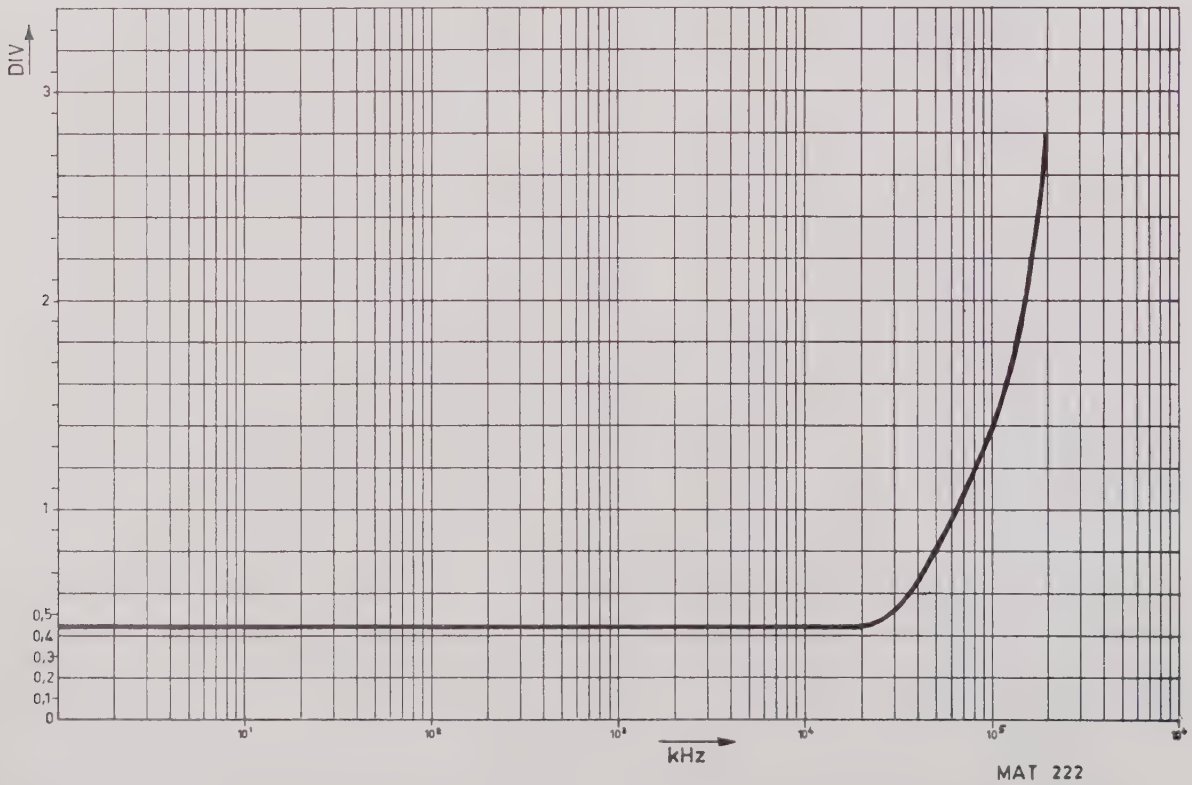
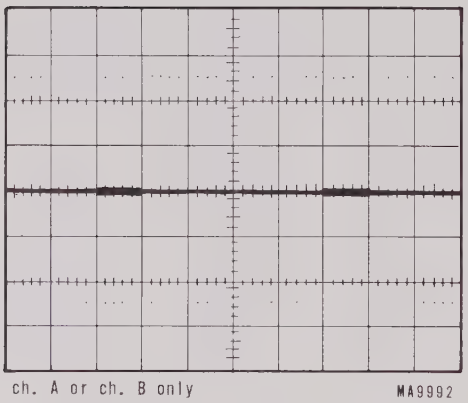
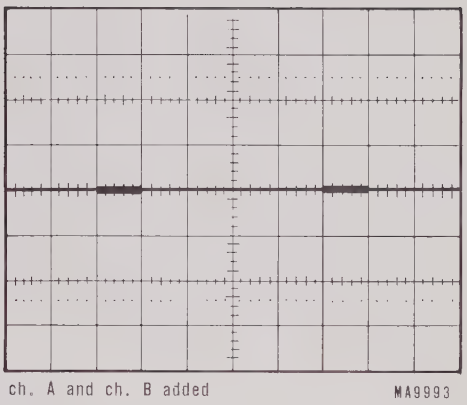


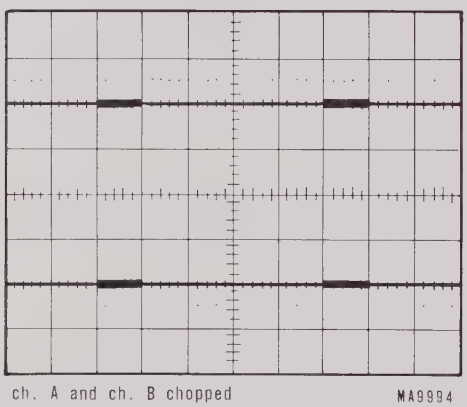
Abb. 1.4. Typische Triggerempfindlichkeit von Kanal A in Abhängigkeit der Frequenz.



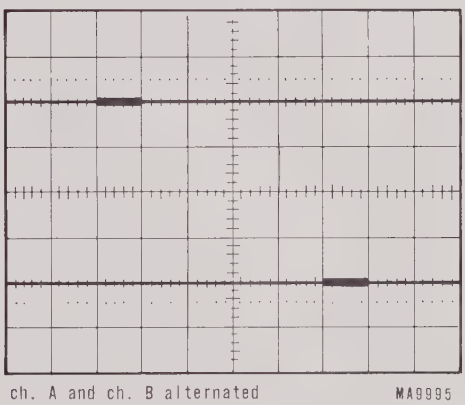
Nur Kanal A oder B



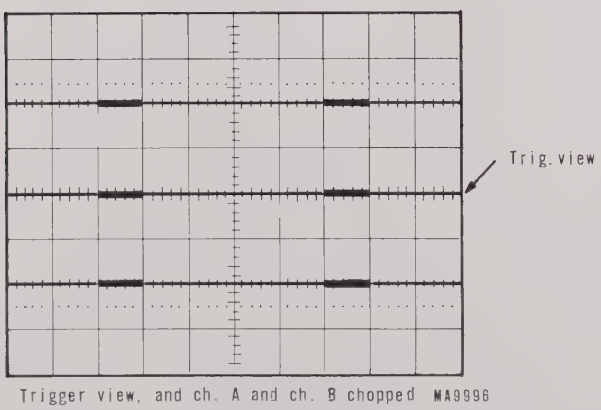
Kanäle A und B addiert



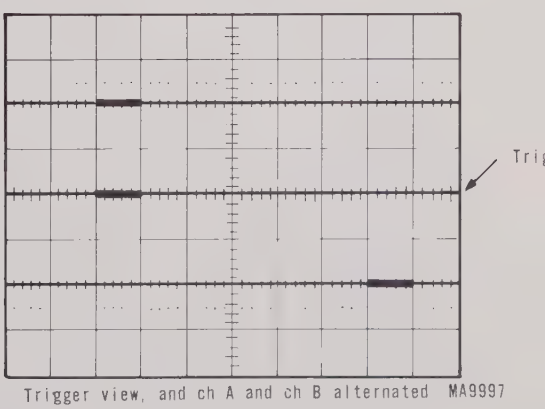
Kanäle A und B gechopped



Kanäle A und B alternierend



Kanäle A, B und Triggerview gechopped



Kanäle A, B und Triggerview alternierend

Abb. 1.5. Ubersicht der verschiedene Darstellungsarten mit doppelte verzögerte Zeitbasis.

2. GEBRAUCHSANLEITUNG

2.1. ALLGEMEINES

Dieser Abschnitt gibt einen Überblick der für die Inbetriebnahme des PM 3263 erforderlichen Handlungen und Vorsichtmassregeln. Er beschreibt und erläutert in kürze die Funktion der Bedienungsorgane auf Frontplatte und Rückwand sowie der Anzeigen. Ausserdem sind hier die praktischen Gesichtspunkte der Bedienung erklärt, dies ermöglicht dem Bedienungsmann eine rasche Bewertung der Hauptfunktionen des Geräts.

2.1.1. Netzspannungseinstellung und Sicherung

Netzspannungsbereichschalter der sich hinter der Rückwand befindet in richtungen Stellung setzen.
Der an der Rückwand angebrachte Sicherungshalter enthält eine Sicherung, 2 A, träge.
Es durfen nur die vorgeschriebenen Sicherungen verwendet werden. Die Verwendung reparierter Sicherungen und das Kurzschliessen des Sicherungshalter sind nicht zulassig. Das Gerät muss von allen Spannungsquellen getrennt sein wenn eine Sicherung ersetzt wird.

2.1.2. Erdung

Vor dem Einschalten muss das Gerät auf eine der folgenden Weisen mit einem Erdschutzleiter verbunden werden.

- über den Erdanschluss (gekennzeichnet ⏚)
- über das dreiadrige Netzkabel. Der Netzstecker darf nur in eine Schutzkontaktdose eingeführt werden. Diese Schutzmassnahme darf nicht unwirksam gemacht werden, z.B. durch Verwendung einer Verlängerungsleitung ohne Schutzleiter.
  Es ist darauf zu achten, dass wenn dieses Gerät "erdfrei" verwendet wird das gesamte Gehäuse die Spannung führt mit welcher die Erdklammer des Messkopfs verbunden ist.

Ersetzen des Netzsteckers geschieht auf eigene Gefahr.

WARNUNG: Jede Unterbrechung des Schutzleiters innerhalb oder ausserhalb des Geräts ist unzulässig. Wenn ein Gerät von kalter in warme Umgebung gebracht wird, kann dies zu einem sicherheitstechnisch gefährlichen Zustand führen. Deshalb sind Erdungsvorschriften sorgfältig zu beachten.

2.1.3. Inbetriebnahme

Bevor irgendeine Verbindung ausgeführt wird muss die Erdanschlussklemme an eine Schutzleiter angeschlossen werden (siehe Abschnitt Erdung).

WARNUNG: Beim Öffnen von Abdeckungen oder Entfernen von Teilen mit Werkzeug können spannungsführende Teile freigelegt werden. Auch können Anschlussstellen spannungsführend und somit Lebensgefährlich sein.
Vor dem Öffnen des Geräts muss das Gerät von allen Spannungsquellen getrennt sein.
Wenn danach eine Kalibrierung, Wartung oder Reparatur am geöffneten Gerät unter Spannung unvermeidlich ist, so darf das nur durch eine Fachkraft geschehen, welche die damit verbundenen Gefahren kennt.
Kondensatoren im Gerät können noch geladen sein, selbst wenn das Gerät von allen Spannungsquellen getrennt wurde, die Schaltbilder sind zu beachten.

2.1.4. Tragbügel

Der Bügel lässt sich drehen wenn die Druckknöpfe auf ihren Lagern eingedrückt werden.

2.1.5. Abdeckhaube

Abnehmen:
- Den Knopf in der Mitte des Deckels eine viertel Umdrehung nach links drehen (Stellung UNLOCKED).
- Deckel abnehmen.

Aufsetzen:
- Den Verriegelungsknopf in Stellung UNLOCKED drehen.
- Deckel an der Vorderseite des Oszillografen befestigen.
- Knopf eindrücken und eine viertel Umdrehung nach rechts drehen (Stellung LOCKED).

Der Raum in der Abdeckhaube dient zum Aufbewahren von Zubehören, wie Tastköpfe, faltbarer Lichtschuztubus, usw.

2.1.6. Einschalten

Der Netzschalter POWER ist gekoppelt mit der Rasterbeleuchtungseinsteller ILLUM und befindet sich an der Vorderseite des Gerätes unter dem Bildröhrenrahmen. Die Anzeige Lampe POWER ON/OFF befindet sich neben Einsteller ILLUM.
Der Oszillograf darf niemals eingeschaltet werden, wenn eine Leiterplatte entfernt wurde.
Eine Leiterplatte darf nicht früher als eine Minute nach Ausschaltung des Gerätes entfernt werden.

2.1.7. Einschalttest

Bei Einschaltung löst der Mikroprozessor einen automatischen Test der internen Schaltungen einschliesslich

- Prozessor Test
- PROM Test
- RAM Test
- LED-Anzeige Test, aus.

Die Testergebnisse erscheinen auf der LED-Anzeige.
Während 0,5 Sek. erscheint von links nach rechts auf jeder Ziffer eine ⊟
Hiernach leuchten die EV, DIV und S oder Hz Lampe 0,5 Sek. lang auf.
Falls die vom Mikroprozessor gesteuerten Schaltungen nicht einwandfrei funktionieren dann erscheinen auf der LED-Anzeige folgende Testergebnisse:

- Die LED-Anzeige bleibt dunkel.
- Prozessor wahrscheinliche Ursache:
- Eine ⊡ in der Ziffer äusserst rechts:
  PROM wahrscheinliche Ursache.
- Eine / in der Ziffer äusserst rechts:
  RAM wahrscheinliche Ursache.

2.2. BEDIENUNGSORGANE UND BUCHSEN

2.2.1. Vertikalablenkung und Elektronenstrahlröhrenteil

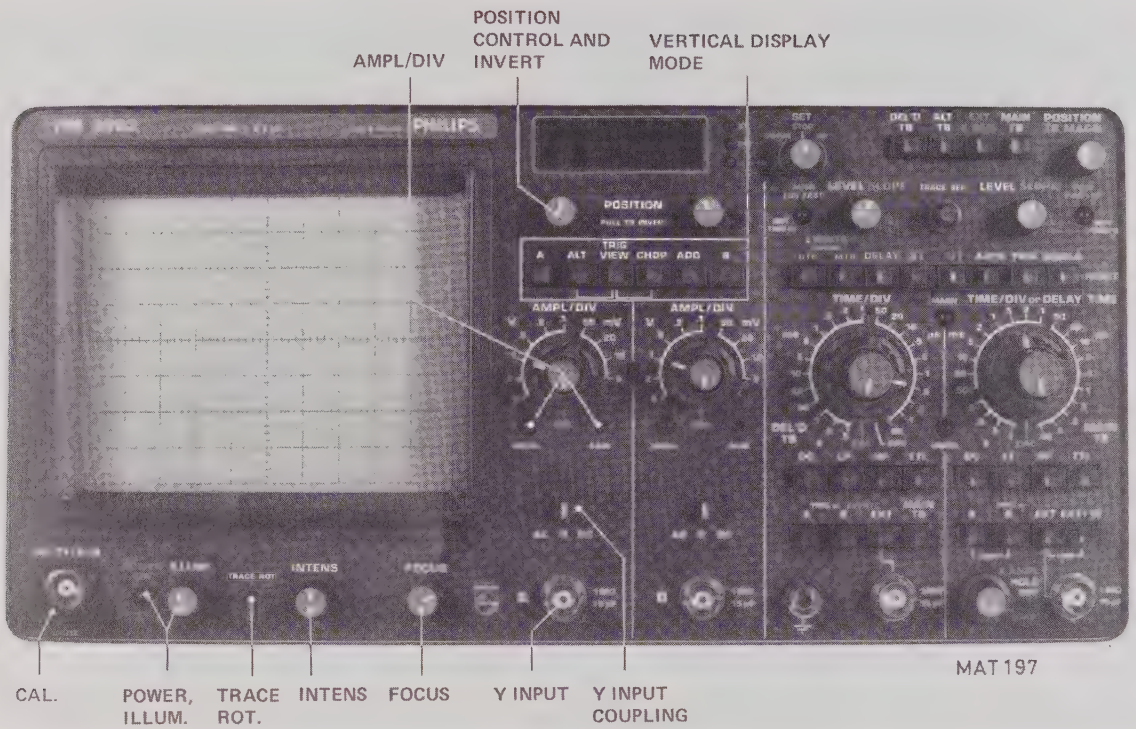


Abb. 2.1. Vertikalablenkung und Elektronenstrahlröhrenteil

– Vertikalablenkung	Wählt die gewünschte Vertikalablenkung
A eingedrückt	Vertikalablenkung durch an Kanal A gelegtes Signal.
ALT eingedrückt	Das Bild wird am Ende (jeder Periode) des Zeitablenksignales von einem Vertikalkanal auf den anderen umgeschaltet, das heisst Kanäle A und B werden auf ALTernierender Ablenkung dargestellt.
TRIG VIEW eingedrückt	Die Anzeige wird für Sichtbarmachung des gewählten Triggersignal geschaltet. Die Darstellung des Triggersignals kann intern über Kanal A oder B geschehen (A oder B eingedrückt) oder extern über die externe Eingangsbüchse, wenn EXT oder EXT/10 eingedrückt ist. Die Darstellung des Triggersignals kann mit Alternierende oder "chopped" ablenkung kombiniert werden.
CHOP eingedrückt	Das Bild wird bei einer Festfrequenz von einem Vertikalkanal zum anderen umgeschaltet, die beiden Kanäle A und B werden während der gleichen Ablenkung sichtbar.
ADD eingedrückt	Vertikalablenkung durch die Summe der Signale von Kanal A und B.
B eingedrückt	Vertikalablenkung durch Signal von Kanal B.
ALT und TRIG VIEW gleichzeitig eingedrückt	Die Signale auf den Kanälen A, B und TRIG VIEW werden während alternierender Ablenkung dargestellt, normalerweise für Hochfrequenzsignale geeignet (siehe auch Erklärung der Drucktaste TRIG VIEW).
CHOP und TRIG VIEW gleichzeitig eingedrückt	Die Triggersignale auf den Kanälen A und B sind eines nach dem anderen bei CHOP Frequenz während der gleichen Ablenkung sichtbar, normalerweise für Niederfrequenzsignale geeignet. (Siehe auch die Erklärung der Drucktaste TRIG VIEW).

Keine der Tasten eingedrückt	Wird keine Taste eingedrückt ist die Betriebsweise des Gerätes wie bei Einstellung ALT.
– Lageeinstellung und Invertierung	
POSITION	Stufenlose Einstellung der vertikalen Lage des Bildes
PULL TO INVERT	Zweiweg Zug-Druckschalter gekoppelt an Einsteller POSITION zur Umkehrung der Signalpolarität. Eindrücken für NORMAL ziehen für INVERT.
AMPL/DIV	Stufenweise Einstellung der Vertikalablenkkoeffizienten mit 11 Stellungen. In Lage 2 mV/Teil ist die Bandbreite auf 35 MHz begrenzt.
CAL (AMPL/DIV)	Stufenlose Einstellung der Vertikalablenkkoeffizienten. In Stellung CAL ist der eingestellte Ablenkkoeffizient kalibriert.
UNCAL	Lampenanzeige warnt dass sich der Einsteller CAL nicht in Kalibrierstellung befindet.
GAIN (Schraubenziehereinstellung)	Kalibrierung der Verstärkung in Stellung CAL.
– Y-Eingangskopplung	
AC, 0, DC	Signalkopplung. Drehschalter mit 3 Stellungen.
AC	Kopplung über einen Sperrkondensator.
0	Verbindung zwischen Eingangsschaltung und Eingangsbuchse wird unterbrochen und der Verstärkereingang geerdet.
DC	Direkte Kopplung.
– Eingang	
A 1 MOhm - 15 pF	BNC Eingangsbuchse für Kanal A
B 1 MOhm - 15 pF	BNC Eingangsbuchse für Kanal B
ELEKTRONENSTRAHLRÖHRE	
CAL	Ausgang der eine 3 Vs-s, 2 kHz Rechteckspannung zur Kalibrierung des Vertikalablenkungs-Steller CAL oder für die Frequenzkompensation von Spannungsleiter-Tastköpfen zur Verfügung stellt. Stromschlinge mit 6 mAs-s für die Kalibrierung von Strommessköpfen.
POWER,ILLUM	Stufenlose Einstellung der Rasterbeleuchtung zugleich Netzschalter (ON/OFF).
POWER ON	Signallampe zeigt an dass der Netzschalter eingeschaltet ist.
TRACE ROT (Schraubenziehereinstellung)	Voreinstellung zur Ausrichtung der Leuchtspur mit den Rasterlinien.
INTENS	Stufenlose Einstellung der Bildhelligkeit.
FOCUS	Stufenlose Einstellung zur Fokussierung des Elektronenstrahls.

2.2.2. Horizontalablenkung

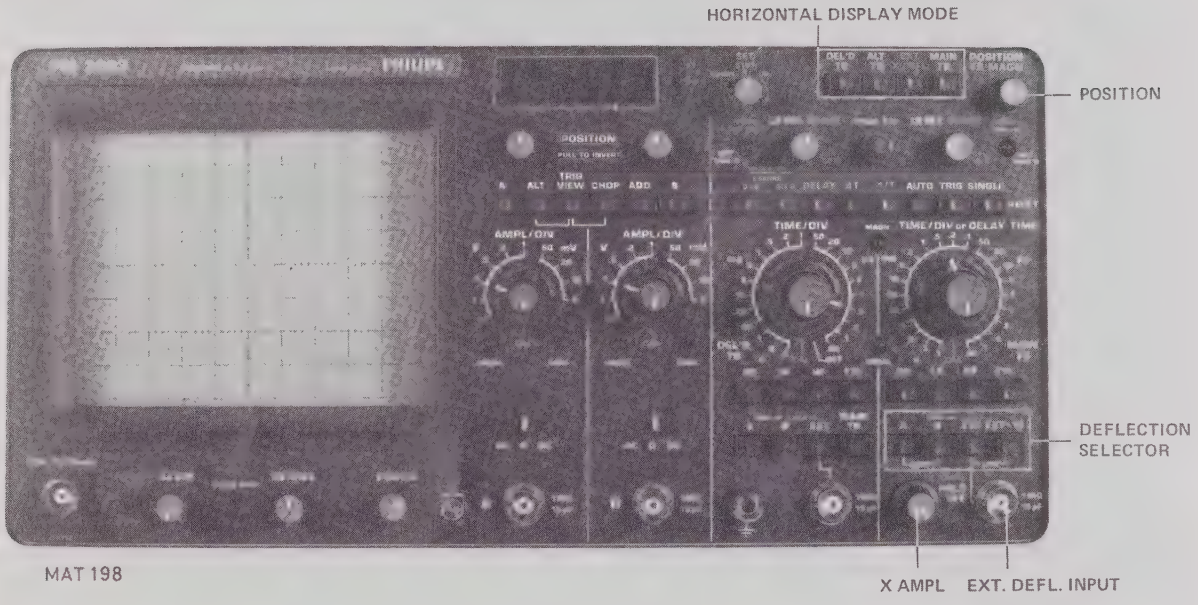


Abb. 2.2. Horizontalablenkung

– Horizontale Darstellungsart	Wählt die gewünschte Horizontalablenkung.
DEL'D TB eingedrückt	Die Horizontalablenkspannung wird vom verzögerten Zeitablenkgenerator geliefert.
ALT TB eingedrückt	Die horizontale Darstellung wird am Ende jedes Sägezahn von der Hauptzeitablenkung auf verzögerte Zeitablenkung umgeschaltet und so weiter. Wenn ALT TB kombiniert wird mit TRIG VIEW, wird MAIN TB mit aufgeheltem DEL'D TB dargestellt.
EXT X DEFL eingedrückt	Horizontalablenkung durch ein an die Eingangsbuchse des Horizontalverstärkers gelegtes Signal, durch ein von Kanal A oder B kommendes Signal, oder ein Netzfrequenzsignal, je nach Einstellung von TRIG oder X DEFL.
MAIN TB eingedrückt	Horizontalablenkspannung wird vom Hauptzeitablenkgenerator geliefert; ein Teil der Darstellung wird aufgehellt (Ausgenommen in Stellung OFF des TIME/DIV Schalters des verzögerten Zeitablenkgenerators).
Keine Tasten eingedrückt	Die gleiche Wirkung wie MAIN TB gedrückt.
– POSITION (TB MAGN)	Stufenlose Einstellung der horizontalen Lage des Bildes; gekoppelt mit einem Zug-Druck-Schalter der den Horizontalablenkkoeffizienten 10 mal steigert (PULL FOR X10).
TRACE SEP.	Stufenlose regelbare Einstellung des vertikalen Abstands zwischen den beiden Zeitablenkungs-Darstellungen in Betriebsart ALT TB.

– Ablenkungswähler	Wähler für externe X–Ablenkung oder Triggerquellenwähler für Hauptzeitbasis X-Ablenkung nur wenn Taste EXT X DEFL des horizontalen Darstellungsartschalters gedrückt ist.
A gedrückt	X-Ablenkung intern von Kanal A.
B gedrückt	X-Ablenkung intern von Kanal B.
EXT gedrückt	Das Signal am externen Eingang wird für X-Ablenkung benutzt.
EXT ÷ 10 gedrückt	Gleich wie oben, jedoch über einen eingebauten 1:10 Spannungsteiler.
LINE (EXT und EXT ÷ 10 gedrückt)	X-Ablenkung intern von der Netzspannung.
– EXT DEFL INPUT	Eingangsbuchse für externe X-Ablenkung.
– X AMPL	Stufenlose Einstellung der X-Ablenkungs Amplitude, kombiniert mit Knopf HOLD OFF. Normalerweise steht dieser Knopf auf CAL.

2.2.3. Hauptzeitbasis

Abb. 2.3. Hauptzeitbasis

TB MAGN	Zug-Druckschalter der den Horizontalablenkkoeffizienten um einen Faktor 10 steigert (PULL FOR X10).
LEVEL-SLOPE	Stufenlose Einstellung des Triggersignalpegels bei welchem der Zeitablenkgenerator startet. Diese Einstellung ist gekoppelt mit einem Zug-Druck-Schalter zur Triggerungswahl auf der positiv oder negativ gerichteten Flanke des Triggersignals (gedrückt "+", gezogen "–").
NOT TRIG'D	Signallampe leuchtet auf wenn die Zeitablenkung nicht getriggert ist, z.B. bei Wartestellung.
– AUTO, TRIG, SINGLE	Triggerart-Einstellungen; Drucktastenschalter mit 3 Stellungen.
AUTO eingedrückt	Liegt kein Triggersignal an so läuft die Hauptzeitbasis frei.
TRIG eingedrückt	Der Zeitablenkgenerator wird auf normale Weise getriggert.
SINGLE, RESET	Eindrücken dieser Taste schaltet einmalige Ablenkung der Hauptzeitbasis ein. Nach Empfang eines Triggersignals läuft die Hauptzeitbasis nur einmal ab. Durch nochmaliges Eindrücken dieser Taste wird die Hauptzeitbasis rückgestellt und ist bereit für den nächsten Triggerimpuls.

Wenn keine Taste eingedrückt ist arbeitet die Schaltung wie in Betriebsart SINGLE.

– MAGN	Signallampe anzeigend dass die 10-fache Dehnung eingeschaltet ist; gilt sowohl für Hauptzeitbasis wie auch für die verzögerte Zeitbasis
– TIME/DIV	Einstellung des Zeitkoeffizienten der Hauptzeitbasis Drehschalter mit 23 Stellungen.

CAL (blau) - TIME DIV	Stufenlose Einstellung des Zeitkoeffizienten der Hauptzeitbasis In Stellung CAL ist der Zeitkoeffizient kalibriert.
UNCAL	Signallampe zeigt an dass sich Einsteller CAL nicht in Kalibrier-einstellung befindet, dies gilt sowohl für die Hauptzeitbasis wie für die verzögerte Zeitbasis.
– TRIG COUPLING	4-Stellungs Drucktastenschalter.
DC eingedrückt	Gesamte Trigger-Bandbreite (einschliesslich DC)
LF eingedrückt	Kopplung über Tiefpass von DC bis 30 kHz (für externe Triggerung über einen Bandfilter von 7 Hz bis 30 kHz).
HF eingedrückt	Kopplung über Hochpass für Frequenzen über 30 kHz.
TTL eingedrückt	Triggerung auf TTL Pegel Pegeleinsteller unwirksam.
Keine Drucktaste eingedrückt	Die Schaltung arbeitet wie mit Taste DC gedrückt.
– TRIG SELECTOR	4-Stellungs Drucktastenschalter.
A eingedrückt	Interne Triggerung auf Kanal A
B eingedrückt	Interne Triggerung auf Kanal B.
COMP (A und B gedrückt)	Interne Triggerung auf Kanälen A und B. Nur im Y alternierent Betrieb.
EXT eingedrückt	Triggerung auf externes Signal über angrenzende EXT TRIG INPUT Buchse.
EXT ÷10 gedrückt	Gleich wie voriges, jedoch über einen eingebauten 1:10 Spannungs-teiler.
LINE (EXT und EXT ÷ 10 gedrückt)	Triggerung intern von Netzspannung.
EXT TRIG INPUT	Eingang für externe Triggerung.
– HOLD OFF	Dieser Knopf ermöglicht Einstellung der Sperrzeit der Hauptzeit-basis und gestattet perfekte Triggerung von beispielsweise Doppelimpulssignalen. Normalerweise steht dieser Knopf auf CAL. Drehen des Knopfes aus Stellung CAL hinweg erhöht die Sperr-zeit. Kombiniert mit stufenlosem Einsteller X AMPL.

2.2.4. Verzögerte Zeitbasis

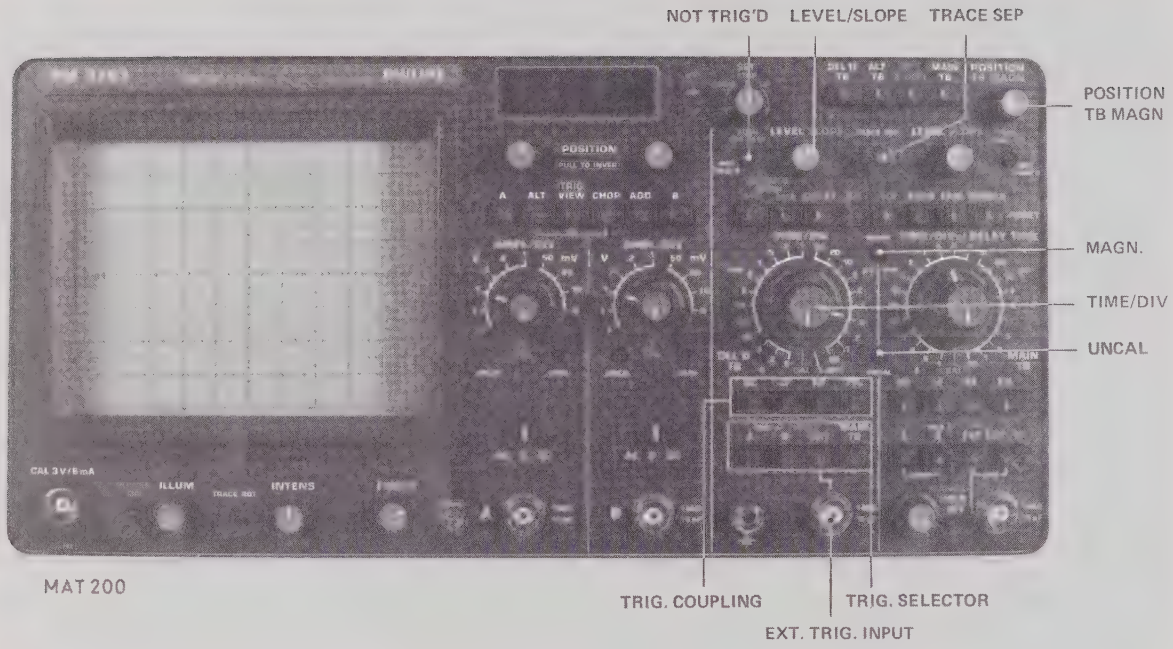


Abb. 2.4. Verzögerte Zeitbasis

POSITION TB MAGN	Stufenlose Einstellung der horizontalen Lage des Bildes; gekoppelt mit einem Zug-Druckschalter der den Horizontalablenkkoeffizienten um einen Faktor 10 erhöht (PULL FOR X10).
TRACE SEP.	Stufenlos regelbare Voreinstellung des Abstand zwischen den beiden Zeitbasis-Darstellungen in Betriebsart ALT TB.
LEVEL-SLOPE	Stufenlose Einstellung des Triggersignalpegels bei welchem der Zeitablenkgenerator startet. Diese Einstellung ist gekoppelt mit einem Zug-Druck-Schalter zur Triggerungswahl auf der positiv oder negativ gerichteten Flanke des Triggersignales. (gedrückt "+", gezogen "—").
NOT TRIG'D	Signallampe leuchtet auf wenn die Zeitablenkung nicht getriggert ist, z.B. bei Wartestellung.
MAGN	Signallampe gibt an dass die X10 Dehnung wirksam ist, gilt sowohl für verzögerte Zeitbasis wie Hauptzeitbasis.
TIME/DIV	Einstellung des Zeitkoeffizienten der verzögerten Zeitbasis Drehschalter mit 23 Stellungen. In Stellung OFF wird die verzögerte Zeitbasis abgeschaltet.
CAL (blau) - TIME/DIV	Stufenlose Einstellung des Zeitkoeffizienten der verzögerten Zeitbasis. In Stellung CAL ist der Zeitkoeffizient kalibriert.
UNCAL	Signallampe zeigt an dass sich Einsteller CAL nicht in Kalibrierstellung befindet.

– TRIG COUPLING	4-Stellungs-Drucktastenschalter
DC eingedrückt	Gesamte Trigger-Bandbreite (einschliesslich DC)
LF eingedrückt	Kopplung über Tiefpass von DC bis 30 kHz (für externe Triggerung über einen Bandfilter von 10 Hz bis 30 kHz).
HF eingedrückt	Kopplung über Hochpass für Frequenzen über 30 kHz.
TTL eingedrückt	Triggerung auf TTL Pegel. Pegeleinsteller unwirksam.
Keine Drucktaste eingedrückt	Die Schaltung arbeitet wie mit eingedrückter Taste DC.
– TRIG SELECTOR	4-Stellungs Drucktastenschalter.
A eingedrückt	Interne Triggerung auf Kanal A nach Verzögerungszeit.
B eingedrückt	Interne Triggerung auf Kanal B nach Verzögerungszeit.
EXT eingedrückt	Triggerung auf externes Signal nach Verzögerungszeit über angrenzende Buchse EXT TRIG INPUT.
MAIN TB gedrückt	Verzögerte Zeitbasis startet sofort nach Verzögerungszeit. Wenn keine Taste gedrückt ist, arbeitet die Schaltung wie mit eingedrücktem Knopf A.
– EXT TRIG INPUT	Eingang für externe Triggerung

2.2.5. Ereigniszählung und Verzögerung

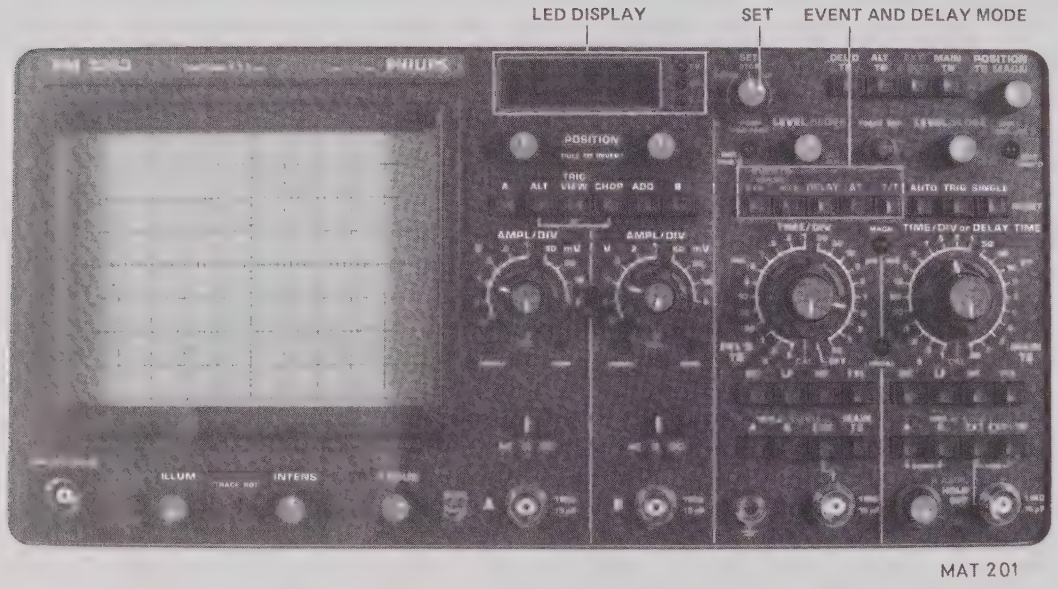


Abb. 2.5. Ereigniszählung und Verzögerung

– LED Anzeige	EV leuchtet	Anzahl der zu zählenden Ereignisse (Impulse) wird angezeigt.
	DIV leuchtet:	Anzahl von Teilen des Elektronenstrahlröhrenbildes in Betriebsart DELAY und Betriebsart ΔT wird angezeigt wenn der MAIN TB Feineinsteller nicht auf CAL steht.
	S or Hz leuchtet:	Wenn Knopf 1/T nicht gedrückt ist wird Zeit angezeigt. Wenn Knopf 1/T gedrückt ist wird Frequenz angezeigt.
Knopf SET		Zur Einstellung der Anzahl der zu zählenden Ereignisse in Betriebsart "Ereigniszählung". Zum Einstellen der DELAY Zeit und der ΔT Intervallzeit in diesen Betriebsarten.
– Betriebsartschalter EVENTS und DELAY		
EVENTS BEFORE DTB		Der Ereigniszähler wird zur Verzögerung der verzögerten Zeitbasis benutzt.
EVENTS BEFORE MTB		Der Ereigniszähler wird zur Verzögerung der Hauptzeitbasis benutzt.
DELAY		Die verzögerte Zeitbasis startet eine gewisse Zeit nach dem Starten der Hauptzeitbasis. Diese Zeit ist mit Knopf SET einstellbar, und ist von der LED-Anzeige ablesbar.
ΔT (Intervall)		Doppelte verzögerte Zeitbasis. Der Intervall zwischen den beiden verzögerten Zeitablenkungen ist mit Knopf SET einstellbar, und ist von der LED-Anzeige ablesbar. Angewandt bei Messungen zwischen zwei Punkten eines komplexen Signals.
1/T		Wenn DELAY oder ΔT Zeit eine Periode des Signals umfasst wird der Frequenz des Signals in der LED Anzeige dargestellt.

2.3. EINIGE ALLGEMEINE INFORMATIONEN DIE ARBEITSWEISE DES PM 3263 BETREFFEND

2.3.1. Eingänge A und B

Der Oszillograf besitzt zwei identische Kanäle, die entweder zusammen mit einem oder beiden Zeitablenkgeneratoren für YT-Messungen, oder aber zusammen mit dem externen Horizontalkanal für XY Messungen verwendet werden können.

YT-Messungen

Zur Darstellung eines Signals ist einer der beiden Vertikalkanäle mit Taste A oder Taste B der Darstellungsartenschalter zu wählen.
Wird Taste ALT oder CHOP gedrückt, können zwei verschiedene Signale gleichzeitig abgebildet werden. Der Y-Ablenkkoeffizient und die Polarität können für jeden Kanal getrennt gewählt werden. Wird Taste ALT betätigt wird die Darstellung beim Rücklauf des Zeitablenksignals von einem Kanal auf den anderen umgeschaltet. Obwohl Stellung ALT für alle Ablenkzeiten verwendet werden kann, ergibt für lange Ablenkzeiten Stellung CHOP eine bessere Bildgüte, da das abwechselnde Darstellen der beiden Eingangssignale während dieser langen Ablenkzeiten deutlicher sichtbar ist.

In Stellung CHOP, wird die Darstellung mit einer Festfrequenz von einem Kanal auf den anderen umgeschaltet. In Stellung ADD des Darstellungsartenschalters werden die Signalspannungen der beiden vertikalen Kanäle addiert. Abhängig von der Stellung der Polaritätsschalter wird entweder die Summe oder die Differenz der Eingangssignale dargestellt. Die Einstellung ADD ermöglicht auch Differenzmessungen. Bei diesen Messungen wird die Gleichtaktunterdrückung der Stellung ADD ausgenützt. Wenn die Polraitätsschalter beider Kanäle in entgegengesetzten Stellungen stehen, werden die Gleichtaktteile der Signale von Kanal A und B im Verhältnis zu den Gegentaktteilen nur sehr geringfügig verstärkt.

XY-Messungen

Wenn Drucktaste EXT X DEFL des Horizontalablenkungsschalters eingedrückt ist, ist der Zeitablenkgenerator ausgeschaltet, wenn Taste A des TRIG OR X DEFL-Schalters eingedrückt ist. Ein Signal das über Kanal A zugeführt wird kann nun zur Horizontalablenkung verwendet werden. Der Schalter AC/0/DC und der Stufenabschwächer von Kanal A bleiben wirksam.
Einsteller X DEFL/HOLD OFF ermöglicht stufenlose Einstellung der Ablenkungskoeffizienten, für horizontale Verschiebung des Bildes wird Einsteller X POSITION verwendet.

Für X-Ablenkung kann auch der vertikale Kanal B verwendet werden.
In diesem Fall Taste B des TRIG OR X DEFL-Schalters eindrücken.

Es ist ferner möglich eine interne Spannung der Netzfrequenz, oder ein Signal angelegt an die EXT Buchse (Vorderseite rechts unten), für die X-Ablenkung zu verwenden. Zu diesem Zweck die betreffende Drucktaste des TRIG OR X DEFL-Schalters eindrücken.
Bei diesen Betriebsarten kann die Bildbreite mit dem X DEFL/HOLD OFF Potentiometer eingestellt werden. Mit diesem Potentiometer in Stellung CAL, beträgt der Ablenkungskoeffizient für externe Signale 50 mV/Teil. Durch Eindrücken der Tasten DC oder LF des Triggerkopplungsschalters der Hauptzeitbasis kann das externe Signal entweder gleichspannungs- oder wechselspannungsgekoppelt werden (untere Frequenzgrenze 7 Hz).

AC/0/DC - Schalter

Die zu beobachtenden Signale sind an die Buchse(s) A und/oder B zu legen und der AC/0/DC Schalter abhängig von der Zusammensetzung der Signale auf AC der DC zu stellen. Da der vertikale Verstärker gleichspannungsgekoppelt ist, ist die ganze Bandbreite des Gerätes verfügbar und die Gleichspannungskomponenten werden in Stellung DC des AC/0/DC-Schalters als Bildverschiebungen sichtbar.
Sind kleine Signale hohen Gleichspannungen überlagert kann dies störend sein. Jede Abschwächung des Signals verursacht auch eine Abschwächung der kleinen Wechselspannungskomponenten. In diesem Falle ist der Eingangsschalter in AC Stellung zu bringen wodurch ein Sperrkondensator die Gleichspannungs- und Niederfrequenz-Signale unterdrückt. Dies hat Dachschräge zur Folge bei Darstellungen von Niederfrequenzsignalen. Stellung 0 unterbricht das Signal und erdet den Verstärkereingang um den 0 V Pegel schnell bestimmen zu können.

2.3.2. Zeitbasis

Die Zeitbasisschaltungen liefern eine Sägezahnspannung um eine lineäre Horizontalablenkung zu erlangen.
Die Horizontalablenkgeschwindigkeit ist kalibriert so dass ein genau zeitbezogenes Bild erhalten wird.
Um ein stabiles Bild zu bekommen muss die Zeitbasis-Sägezahnspannung jedesmal an der gleichen Stelle der Signalform gestartet werden (dies wird Triggerung genannt).

Hauptzeitbasis

Bei der Hauptzeitbasis unterscheidet man drei Betriebsarten:

AUTO : Der Zeitablenkgenerator ist freilaufend solange keine Triggerung vorhanden ist. Sobald ein Triggersignal anliegt wird ein stabiles Bild erlangt.

TRIG : Der Zeitablenkgenerator läuft nur wenn ein Triggersignal vorhanden ist. Wenn kein Triggersignal vorhanden ist bleibt der Bildschirm dunkel.

SINGLE : Der Zeitablenkgenerator läuft nur einmal nach Empfang eines Triggerimpulses. Diese Betriebsart wird meist dann angewandt, wenn einmalige Vorgänge photographiert werden sollen. Nach einer einmaligen Ablenkung (SINGLE Sweep) ist die Zeitbasis durch nochmaliges Eindrücken der Taste SINGLE zum Empfang des nächsten Triggerimpulses bereit.

Variable "hold-off" Zeit

Die "hold-off" Zeit (Sperrzeit) ist die Zeit zwischen dem Ende einer Zeitablenkung und dem Moment bei welchem die Schaltung zur Triggerung am nächsten Triggerimpuls bereit ist. Bei komplexen Signalen (z.B. Doppelimpulssignale) kann normalerweise Doppeltriggerung vorkommen, was ein unstabiles Bild zur Folge hat. Mit Hilfe von Steller HOLD OFF kann die Sperrzeit, um Doppeltriggerung zu vermeiden, eingestellt werden. Mit HOLD OFF in Stellung CAL hat die Sperrzeit ihren niedrigsten Wert.

Verzögerte Zeitbasis

Der verzögerte Zeitablenkgenerator ist im Grunde der gleiche wie der Hauptzeitablenkgenerator.
Der verzögerte Zeitablenkgenerator ist jedoch nur während der Hauptzeitablenkung wirksam.
Die verzögerte Zeitbasis wird gewöhnlich zur näheren Betrachtung von Einzelheiten in komplexen Signalen.
Wenn Taste DEL'D TB gedrückt ist wird nur die verzögerte Zeitablenkung dargestellt.

Wenn die Taste MAIN TB der verzögerten Zeitbasis-Triggerquelle gedrückt ist, wir die verzögerte Zeitablenkung an einem bestimmten Zeitpunkt während der Hauptzeitablenkung starten.
Die verzögerte Zeitbasis startet dann ohne Triggerung; die Verzögerungszeit ist in der LED-Anzeige sichtbar.

Als Folge eines möglichen grossen Ablenkzeitverhältnisses zwischen verzögerter Zeitbasis und Hauptzeitbasis kann etwas Jitter entstehen wenn nur die verzögerte Zeitbasis dargestellt wird. Durch Triggerung der verzögerten Zeitbasis (mit A, B oder EXT) lässt sich das Jitter unterdrücken. Da die Zeit in der LED-Anzeige jetzt nicht mehr zuverlässig ist wird UNCAL 1 gezeigt.

Das Oszilloskop PM 3263 hat eine doppelt verzögerte Zeitbasis (ΔT Betrieb).
Dadurch erhält man zwei verzögerte Zeitablenkungen auf einer Hauptzeitablenkung.
Die verzögerte Zeitablenkung wird auf eine kurze Zeit eingestellt um eine Markenfunktion zu erlangen.
Die Verzögerungszeit und die ΔT Zeit können in der LED-Anzeige sichtbar gemacht werden.

Eine weitere Möglichkeit des PM 3263 ist Triggerung nach Ereigniszählung, sowohl für Hauptzeitbasis oder verzögerte Zeitbasis. Die Anzahl von Ereignissen (Impulsen) kann für jeden beliebigen Wert zwischen 0 und 99999 eingestellt werden.

Der Ereigniszähler zählt nur Triggerimpulse die in der Triggerschaltung der verzögerten Zeitbasis vorhanden sind.
Der Ereigniszähler beginnt zu zählen wenn der Hauptzeitbasis-Triggerimpuls anliegt.

Dehnung der Zeitablenkung MAGN

Die Dehnung der Zeitablenkung wird mit einem Zug-Druck-Schalter der an den Einsteller für horizontale POSITION gekoppelt ist, eingestellt. Wenn dieser Schalter in Stellung X10 gezogen ist wird ein 10 mal schnellerer Zeitmasstab des Hauptzeitablenkgenerators eingestellt. Folglich wird der Signalteil, welcher in der X1 Stellung (TB MAGN eingedrückt) über eine Breite von ein Teil (DIV) in der Schirmmitte dargestellt wird, in der X10 Stellung über die Gesamtbreite des Schirmes geschrieben.
Jeder Teil des Bildes kann mit dem horizontalen POSITION Einsteller zur genauen Beobachtung sichtbar gemacht werden.
In der X10 Stellung wird der Zeitkoeffizient durch Teilen des gegebenen Wertes TIME/DIV durch 10 ermittelt.

Wenn TB MAGN eingeschaltet ist verändert die LED-Anzeige nicht sondern bleibt im normalen Zustand (X1).

Gebrauch der alternierenden Zeitablenkung ALT TB

Das PM 3263 ist mit Darstellungsumschaltung ausgerüstet. Diese Vorrichtung erlaubt dem Gebraucher gleichzeitige Darstellung des Signals an den beiden von der Hauptzeitablenkung und von der verzögerten Zeitablenkung zur Verfügung gestellten Zeitmasstäben.

Genauere Beobachtung eines bestimmten Abschnitts der Hauptzeitbasis-Darstellung wird durch Erweiterung des betreffenden Zeitintervalls mit Hilfe der verzögerten Zeitbasis ermöglicht. Durch Wahl einer entsprechend schnelleren Ablenkung für TIME/DIV der verzögerten Zeitbasis wird die Erweiterung erzielt.
Der von der verzögerten Zeitbasis ausführlich zu beobachtende Teil des Signals bleibt als ein aufgehellter Bildausschnitt der Hauptzeitbasis. Dies erleichtert nicht nur die Lokalisierung des gewünschten Details, sondern dient auch als Sichtanzeige des zu betrachtenden Ausschnitts des Gesamtbildes. Man kann auf sofort das Detail mit dem Signal, welches sehr komplex sein kann, in Beziehung bringen, ohne dabei zwischen MAIN TB und DEL'D TB schalten zu müssen.
Mit TRACE SEP ist die Vertikalverschiebung zwischen den beiden Zeitbasen kontinuierlich einstellbar.

2.3.3. Triggerung

Wenn ein Signal dargestellt werden soll, muss, um ein stillstehendes Bild zu erhalten, die Horizontalablenkung stets an einem festen Punkt des Signals gestartet werden.
Der Zeitablenkgenerator wird folglich von in der Triggereinheit erzeugten schmalen Triggerimpulsen gestartet und durch ein Signal gesteuert das entweder den vertikalen Eingangssignalen, einer internen Netzfrequenzspannung oder einer externen Quelle entstammen kann.

In der Triggereinheit werden die Triggerimpulse durch Vergleich des Eingangssignals mit einer einstellbaren Gleichspannung (LEVEL) gewonnen.
Der Triggerpegel ist bei interner Triggerung (A oder B) auf die vertikale Ablenkrate und bei EXT Triggerung auf die Eingangsspannung bezogen.

Triggerkopplung

Mit Schalter DC/LF/HF/TTL kann man vier verschiedene Triggerkopplungsarten wählen. In den Stellungen HF und LF ist die Übertragungscharakteristik begrenzt.
In Stellung DC wird das Triggersignal unverändert durchgelassen.
In Stellung LF wird ein 0 Hz (7 Hz bei externer Triggerung) bis 30 kHz Bandpass eingesetzt. Diese Stellung dient zur Verminderung von Störungen durch Rauschen.
In Stellung HF wird ein 30 kHz Hochpass eingesetzt. Diese Stellung kann zum Herabsetzen von Störungen durch Brummen verwendet werden.
Stellung TTL ermöglicht automatische Triggerung auf TTL-Pegeln.
Das Triggerfenster hat nun einen festen Wert (Steller LEVEL ist nicht wirksam).

Triggerquelle

Das Triggersignal kann intern Kanal A oder B entnommen werden oder extern über Buchse EXT. Bei interner Triggerung wird das interne Triggersignal von stufenlosen Steller AMPL nicht beeinflusst.

Hauptzeitbasis

Die Hauptzeitbasis kann auch über eine 1:10 Spannungsabschwächerschaltung getriggert werden, wodurch höhere externe Triggerspannungen möglich sind.
Zusammengesetzte Triggerung (composite) wird durch Eindrücken der beiden Tasten A und B gewählt. Bei dieser Betriebsart wird die Triggerspannung Kanal A oder B entnommen, je nachdem welcher Kanal am Schirm erscheint. Zusammengesetzte Triggerung ist nicht anwendbar in der CHOP'D Mode, denn der Chopperspannung wird dann als Triggerspannung verarbeitet.

Netztriggerung (= Triggerung durch ein Signal von der Netzspannung) wird gewählt wenn die beiden Tasten EXT und EXT÷10 gedrückt sind.

2.3.4. Mikroprozessor

Die hauptsächlichen Aufgaben des Mikroprozessors sind:

- Prüfung der Stellung der verschiedenen Bedienungsorgane auf der Frontplatte
- Laden der LED-Anzeige
- Laden des Ereigniszählers
- Laden des Digital-Analog Umsetzers um die Vergleichsspannung der verzögerten Zeitbasis zu erhalten.
- Errechnen des 1/T Wertes.

2.4. GRUNDEINSTELLUNGEN

2.4.1. GAIN-Kalibrierung

- Drucktaste A des Darstellungsartenschalters betätigen.
- Drucktaste AUTO des Triggerartenschalters betätigen.
- Drucktaste MAIN TB des Horizontalablenkungsschalters betätigen.
- Bild mit Einsteller POSITION zentrieren.
- Mit LEVEL, INTENS und FOCUS ein scharfes und deutliches Bild einstellen.
- Schalter AC-0-DC in Stellung DC.
- Schalter AMPL in Stellung 0,5 V und stufenlosen Einsteller in Stellung CAL.
- Buchse CAL mit Eingangsbuchse A verbinden.
- Prüfen ob die Bildhöhe 6 Teile beträgt.
  Nötigenfalls Einstellung GAIN unter dem Schalter AMP neu einstellen.

Bei Verwendung eines 1:10 Abschwächer Tastkopfs, den Schalter AMPLitude auf 50 mV/DIV. Den Rechtecksignal Frequenzgang des Tastkopfs prüfen.
Für Kanal B wiederholen.

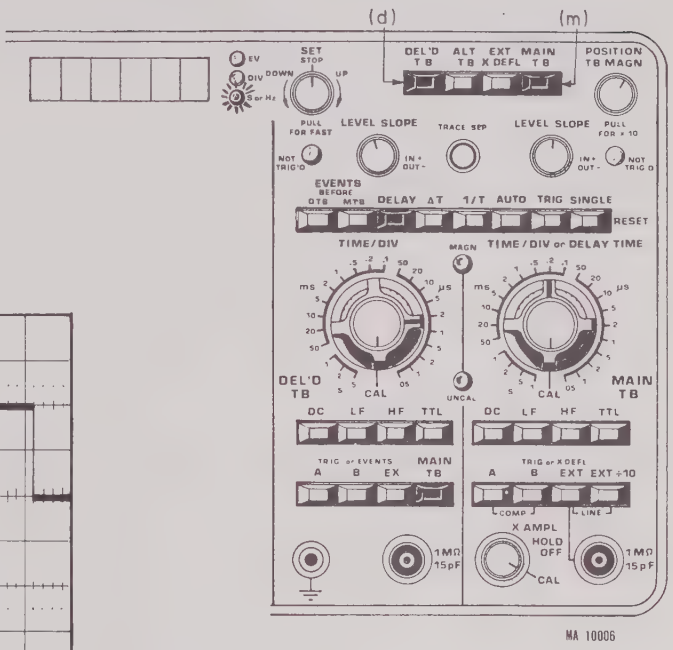
2.4.2. Ausrichten der Leuchtspur (TRACE ROT)

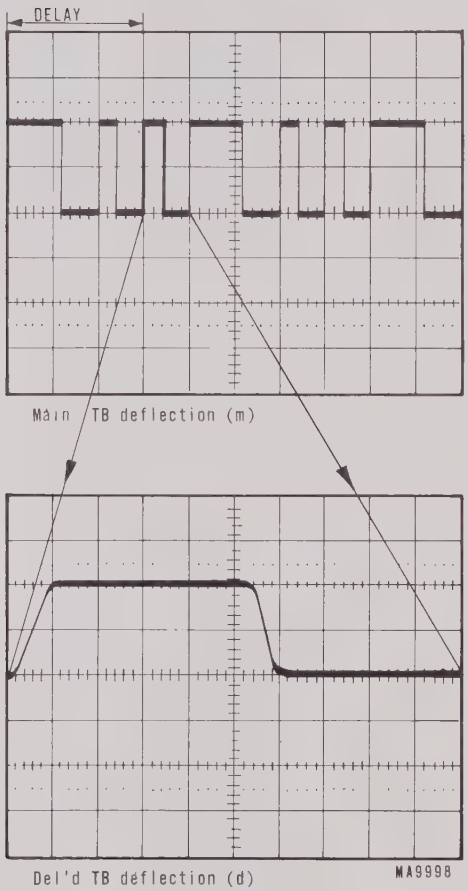
- Drucktaste A des Darstellungsartenschalters betätigen.
  Drucktaste MAIN TB des Horizontalablenkungsschalters betätigen.
- Die Zeitbasislinie mit Einsteller POSITION zentrieren.
- Kontrollieren dass die Zeitbasislinie genau parallel zur horizontalen Rasterlinie liegt; falls erforderlich Steller TRACE ROT auf der Frontplatte, von neuem einstellen.

2.5. EINGEHENDE BESCHREIBUNG VON VERZÖGERUNGS- UND EREIGNISZÄHLBETRIEB

2.5.1. Delay Betrieb

In dieser Betriebsart sind sowohl die Hauptzeitbasis wie auch die verzögerte Zeitbasis wirksam.
Die verzögerte Zeitablenkung wird während der Hauptzeitablenkung aufgehellt.





Die Verzögerungszeit (Delay) nach welcher die Verzögerte Zeitbasis startet erscheint in der LED-Anzeige. Es wird eine Mantisse und ein Zehn-Exponent angezeigt.
Der Exponent kann dunkel (0) –3 oder –6 sein, was für sec., msec bzw. µsec. steht.
Die Einstellung der Verzögerungszeit geschieht mit Hilfe des Knopfs SET.
In vorigen Oszilloskopmodellen geschah die Einstellung der Verzögerungszeit mit einem kalibrierten 10-Gangs Drehknopf, der einen Faktor (zwischen 0 und 100 %)angab mit welchen die Hauptzeitablenkung multipliziert werden musste um die Verzögerungszeit zu erlangen.
Im jetzigen System hingegen wird die Verzögerungszeit direkt in der LED-Anzeige sichtbar.

Durch Wählen der DEL'D TB Ablenkung (d) wird die verzögerte Zeitablenkung über den gesamten Schirm sichtbar. Auf diese Weise lässt sich der Startpunkt der verzögerten Zeitbasis genau einstellen um eine optimale Genauigkeit der Verzögerungszeit-LED-Anzeige zu erhalten. Es ist zu beachten dass der in der LED-Anzeige sichtbare Maximumwert der gesamten Hauptzeitbasis-Ablenkzeit gleichkommt.
Da in obig beschriebener Betriebsart DELAY die verzögerte Zeitbasis an einem bestimmten Punkt* der Hauptzeitablenkung gestartet wird kann einiges Jitter vorkommen. Un ein jitterfreies Elektronenstrahlröhrenbild zu erlangen kann die verzögerte Zeitbasis durch A, B oder EXT Triggerwahl getriggert werden; die LED-Anzeige zeigt UNCAL 1.

LED DIV

Wenn die MAIN TB Feineinstellung nicht auf CAL steht, dann kann die LED-Anzeige die DELAY Zeit nicht in Sekunden (oder msec oder µsec) anzeigensondern wird sie in Schirmteilen angezeigt.
In diesem Fall leuchtet Lampe DIV und die Lampe S or Hz ist aus.

TB MAGN

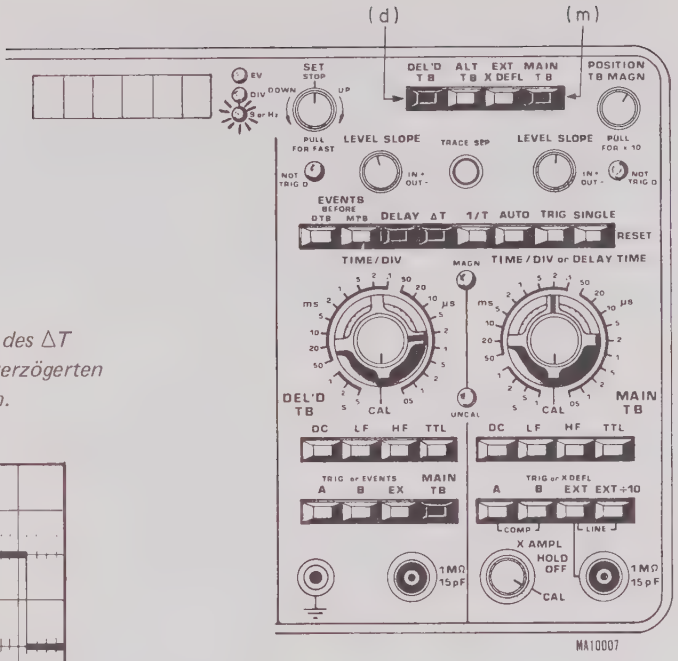
Wenn TB MAGN eingeschaltet ist, verändert die LED Anzeige nicht sondern bleibt in normalen Zustand (x1).

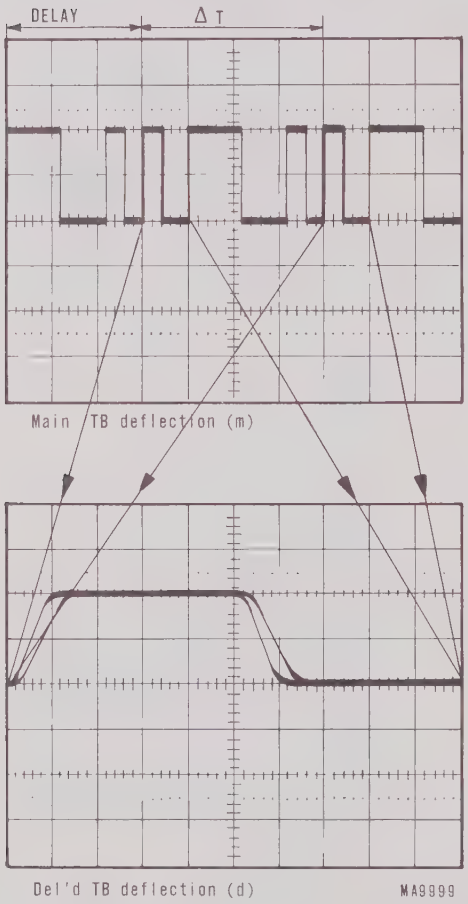
*) *Tatsächlich wird die Sägezahnspannung mit einer dem LED-Anzeigewert entnommenen Gleichspannung verglichen.*

2.5.2. DELAY und ΔT Betrieb

Diese Betriebsart ist eine Erweiterung des DELAY-betriebs. Durch Drücken des ΔT Knopfs erreicht man dass auf dem Schirm der Elektronenstrahlröhre zwei verzögerte Zeitablenkungen während der Hauptzeitablenkung erscheinen*.

Bemerkung: Bei der Anfangseinstellung des ΔT Betriebs fallen die beiden verzögerten Zeitbasismarken zusammen.





ΔT ist die Zeit die zwischen den Startpunkten der beiden verschiedenen verzögerten Zeitablenkungen am Elektronenstrahlröhrenschirm verstreicht.

Der ΔT Betrieb eignet sich besonders für Zeitmessungen in komplexen Signalen. Die beiden verzögerten Zeitablenkungen dienen als Marken.

Sowohl Verzögerungszeit wie ΔT sind mit Knopf SET einstellbar. Durch Einstellung der DEL'D TB Ablenkung (d) werden die beiden verzögerten Ablenkungen über den gesamten Elektronenstrahlröhrenschirm dargestellt. Das Zusammenfallen beider verzögerter Ablenkungen lässt sich mit Knopf SET einstellen, so dass die genaue ΔT in der LED-Anzeige erscheint.

Es ist zu beachten dass zur Einstellung der Verzögerungszeit nur Knopf DELAY eingedrückt werden muss. Die ΔT kann eingestellt werden wenn Knopf ΔT eingedrückt ist.

Der Maximumwert von Verzögerungszeit und ΔT sind jede der totalen Hauptzeitbasis-Ablenkzeit gleich.
Wenn die Zeit in ΔT Betrieb eingestellt wird, ist es möglich dass die Summe: Verzögerungszeit und ΔT Zeit die Ablenkzeit der Hauptzeitbasis überschreitet.
Die ΔT Marke verschwindet jedoch nicht von Schirm der Elektronenstrahlröhre, sondern stoppt am Ende der Hauptzeitablenkung.
Die ΔT Zeit bleibt in einem internen Speicher, so dass wenn der Wert der Verzögerungszeit verringert ist die ΔT Marke in einem bestimmten Augenblick wieder verschiebt.

LED DIV

Wenn die MAIN TB Feineinstellung nicht auf CAL steht, dann kann die LED-Anzeige die ΔT Zeit nicht in Sekunden (oder msec oder µsec) anzeigen, sondern wird sie in Schirmteilen angezeigt. In diesem Fall leuchtet Lampe DIV und die Lampe S or Hz ist aus.

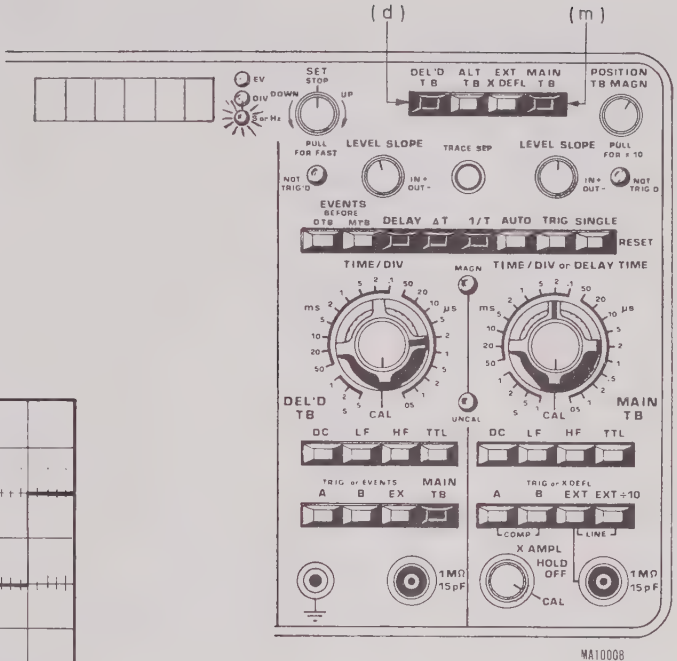
TB MAGN

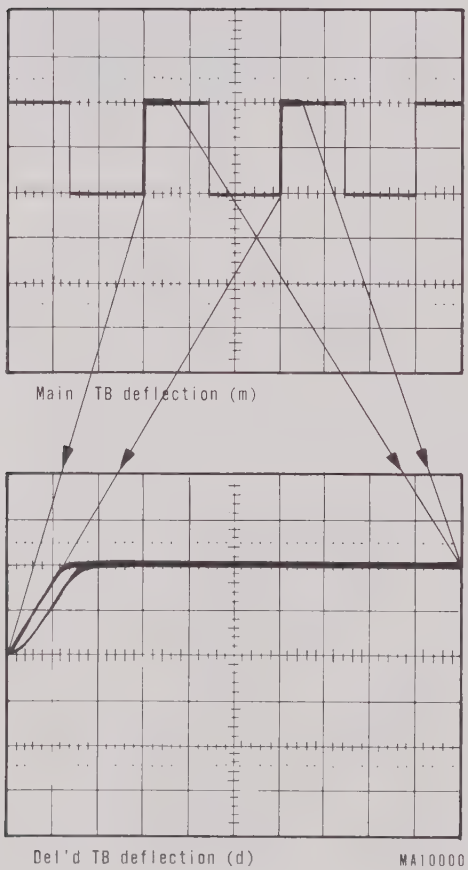
Wenn TB MAGN eingeschaltet ist, verändert die LED-Anzeige nicht sondern bleibt in normalen Zustand (x1).

*) *Tatsächlich wird die verzögerte Zeitablenkung DELAY auf eine Hauptzeitablenkung geschrieben und die verzögerte Zeitablenkung DELAY und ΔT auf die folgende Hauptzeitablenkung und so weiter.*

2.5.3. 1/T Betrieb

Diese Betriebsart ist eine Erweiterung des ΔT-Betriebs. Eindrücken der Taste 1/T erlaubt Frequenzmessungen.

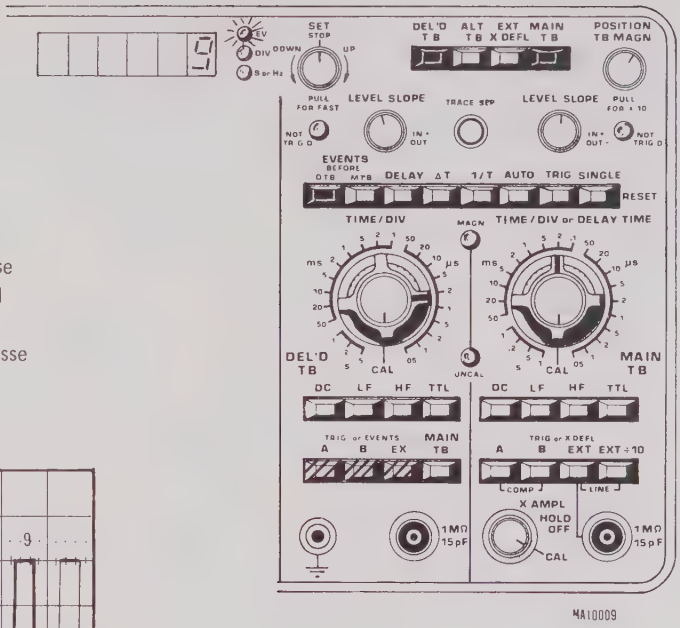


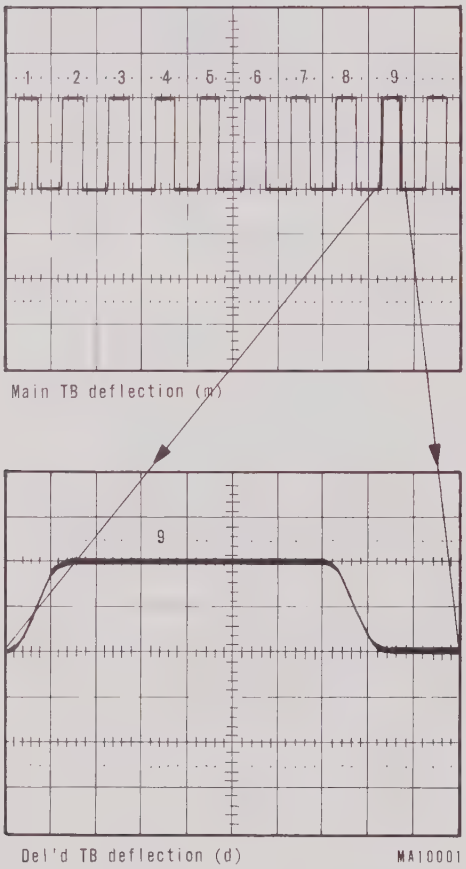


Einstellen der beiden Marken am gleichen Punkt von zwei aufeinander folgende Zyklen eines Signals ermöglicht die direkte Ablesung der Frequenz dieses Signals von der LED-Anzeige.
Zur genauen Einstellung der Marken die Horizontal-ablenkung DEL'D TB einstellen und kontrollieren dass die beiden Marken zusammenfallen.

2.5.4. Ereignisse vor DTB

In dieser Betriebsart wird die verzögerte Zeitbasis nach Zählung einer voreingestellten Anzahl von Ereignissen (Impulsen) getriggert. Die verzögerte Zeitbasis muss von A, B oder EXT getriggert werden. Die Anzahl der zu zählenden Ereignisse ist in der LED-Anzeige ersichtlich und ist mit Knopf SET einstellbar. Maximal können bis zu 99999 Ereignisse gezählt werden.





Beachten, dass wenn Knopf MAIN TB der verzögerten Zeitbasis-Triggerwahlschalter gedrückt ist in der LED-Anzeige die Angabe "ERROR" (Fehler) erscheint (weil dann kein Triggersignal vorhanden ist).

Der Ereigniszähler beginnt im Moment des Starts der Hauptzeitablenkung zu zählen.

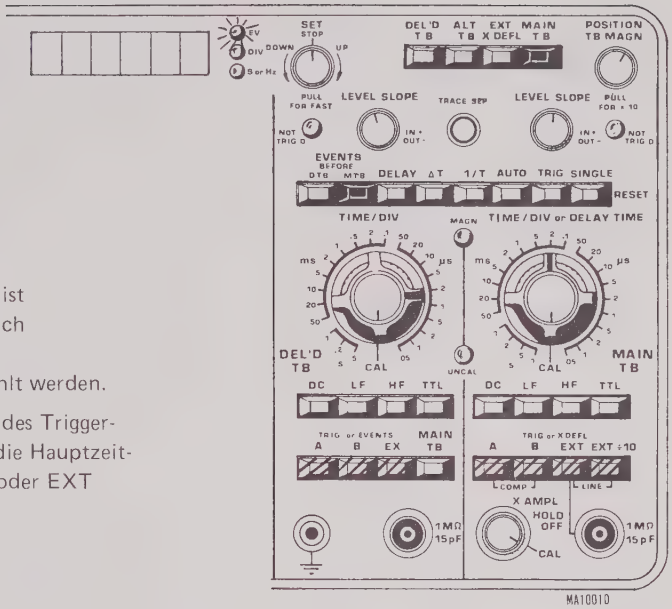
Wenn die Lampe NOT TRIG'D der verzögerten Zeitbasis leuchten bleibt, ist es möglich dass eine grössere Anzahl Ereignisse eingestellt ist als während einer Hauptzeitablenkung zur Verfügung stehen, oder der Triggerregler ist nicht richtig eingestellt.

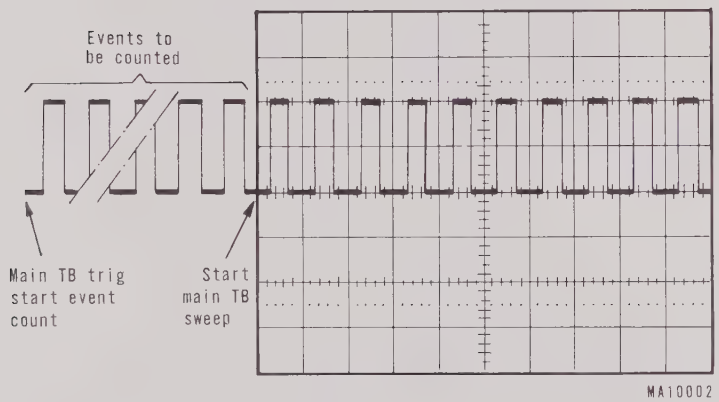
2.5.5. Ereignisse vor MTB

In dieser Betriebsart wird die Hauptzeitbasis nach Zählung einer voreingestellten Anzahl von Ereignissen (Impulsen) welche der verzögerten Zeitbasis-Triggerschaltung (A, B oder EXT) zugeführt wurden, getriggert.

Die Anzahl der zu zählenden Ereignisse ist in der LED-Anzeige sichtbar und lässt sich mit Hilfe von Knopf SET einstellen. Maximal können 99999 Ereignisse gezählt werden.

Der Ereigniszähler beginnt bei Ankunft des Triggerimpulses der Hauptzeitbasis zu zählen; die Hauptzeitbasisschaltung muss ebenfalls von A, B oder EXT getriggert werden.





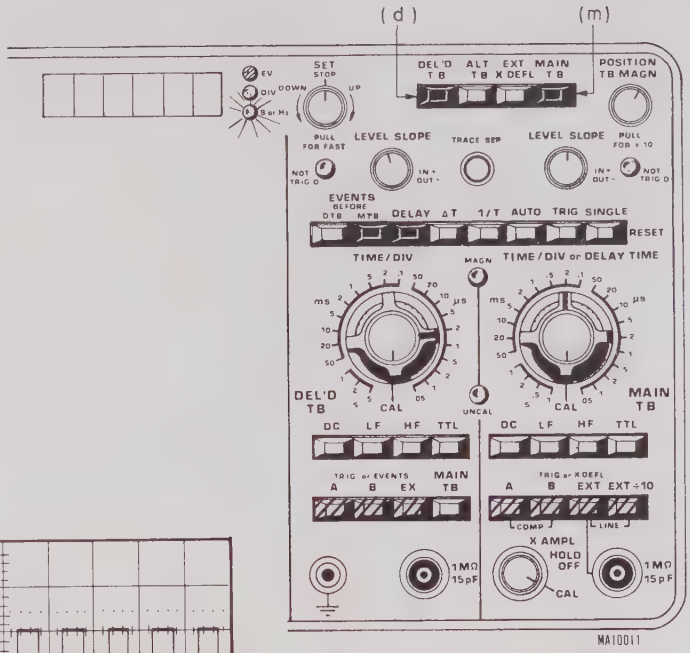
Zum besseren Verständnis sind die zu zählenden Ereignisse hier links neben dem Elektronenstrahlröhrenbild veranschaulicht.

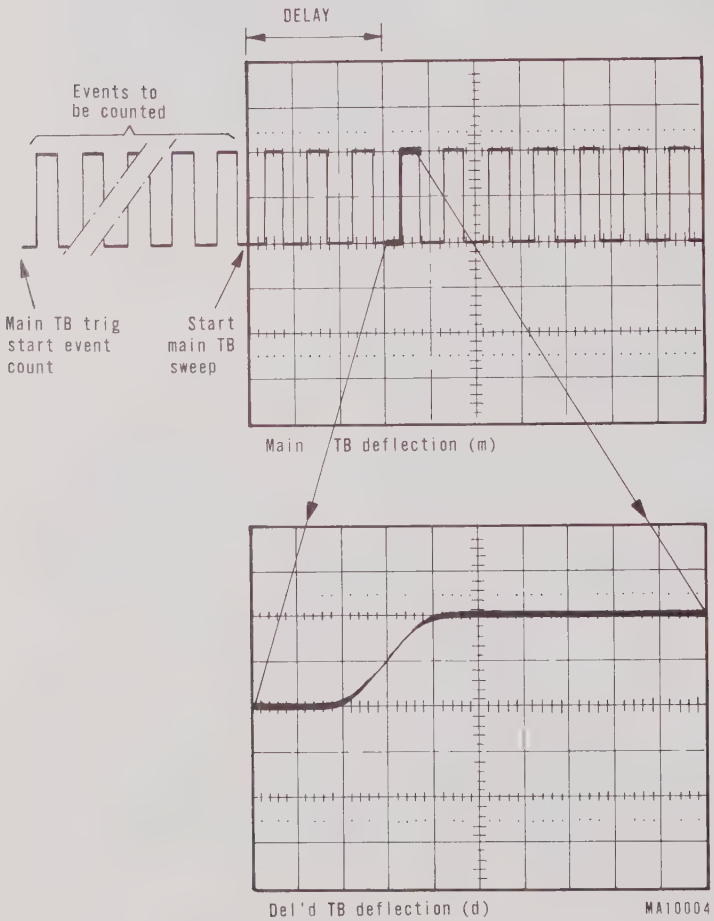
Die Betriebsart EVENTS BEFORE MTB ist geeignet zur gemeinsamen Anwendung mit den Betriebsarten DELAY und ΔT.

2.5.6. Ereignisse vor MTB und DELAY

Dies ist eine Erweiterung der hiervor beschriebenen Betriebsart. Die Hauptzeitbasis triggert nach Zählung einer voreingestellten Anzahl von Ereignissen (Impulsen) die in der Triggerschaltung der verzögerten Zeitbasis (A, B oder EXT).

Erst nur EVENTS BEFORE MTB eindrücken und die Anzahl der zu zählenden Ereignisse wählen.



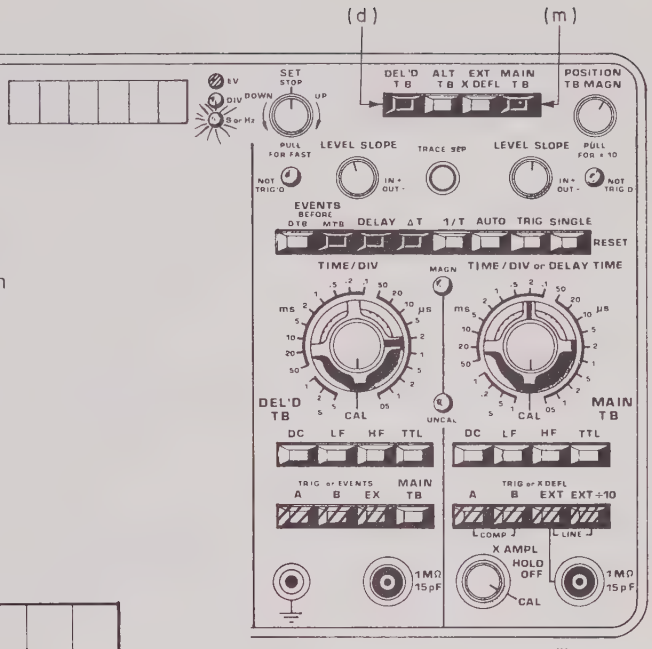


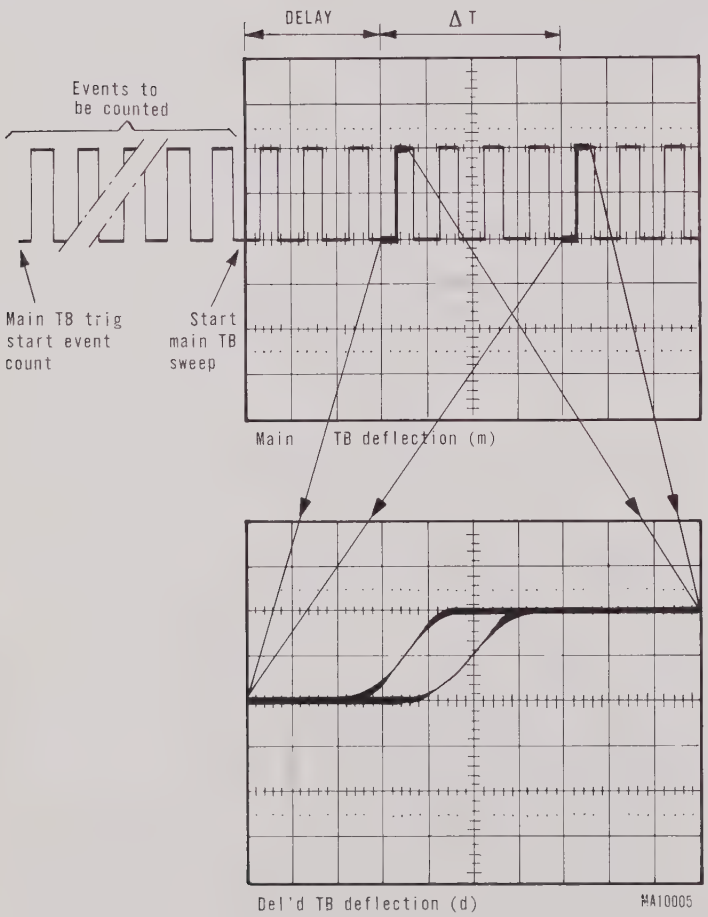
Danach auch DELAY drücken und die Verzögerungszeit einstellen.

2.5.7. Ereignisse vor MTB und DELAY und ΔT

Dies ist eine weitere Erweiterung der Betriebsart EVENTS BEFORE MTB. Die beiden verzögerten Zeitablenkungen können als Marken benutzt werden, ΔT ist der Zeitintervall zwischen den Marken. Die Hauptzeitbasis triggert nach Zählung einer voreingestellten Anzahl von Ereignissen die in der Triggerschaltung der verzögerten Zeitbasis (A, B oder EXT) vorhanden sind.

Erst nur EVENTS BEFORE MTB drücken und die Anzahl der zu zählenden Ereignisse wählen.

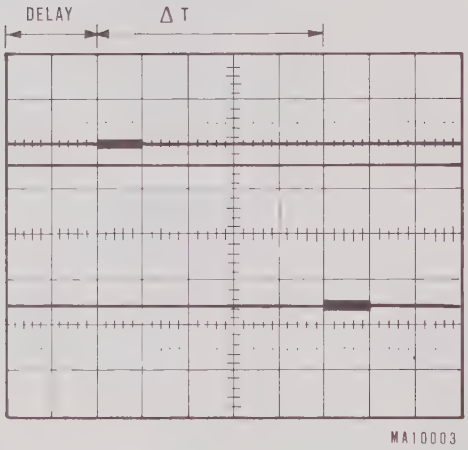




Danach auch DELAY eindrücken und die Verzögerungszeit (die Lage der ersten Marke) einstellen.
ΔT ebenfalss drücken und die Intervallzeit (die Lage der zweiten Marke) einstellen.
Zur genauen Einstellung der Marken die Horizontalablenkung DEL'D TB einstellen und kontrollieren ob beide Marken übereinstimmen.

2.5.8. Verzögerung und ΔT betrieb kombiniert mit alternierender Anzeige

Wenn diese Betriebsart eingestellt ist zeigt das A-Signalbild nur die erste verzögerte Zeitablenkung und das B-Signalbild zeigt nur die zweite verzögerte Zeitablenkung.



Diese Betriebsart ist nützlich für Zeitmessung zwischen zwei verschiedenen Teilen zweier Signale.
Beide Signale müssen zeitbezogen sein (z.B. vom gleichen Taktgeber synchronisiert).

Ein Signal an den A-Kanal Eingang legen und das andere an den B-Kanal Eingang.
Hauptzeitbasis Triggerquelle kann von A, B oder EXT kommen.
Beide Signalteile durch Einstellung der DELAY und der DELAY und ΔT Zeit wählen.
Die Zeit zwischen dem Beginnpunkt der beiden aufgehellten Signalbildteile erscheint in der LED-Anzeige.
Für genaue Einstellung die Horizontalablenkung DEL'D TB wählen.

2.5.9. LED-Anzeige mit Steller "SET"

Diese Anzeige ist 6-stellig und leuchtet wenn:

1° EVENTS BEFORE MTB gewählt ist

oder

2° Knopf DTB TIME/DIV nicht in Stellung OFF steht.

und

EVENTS BEFORE DTB
oder DELAY
oder ΔT
} gewählt ist

Unabhängig von oben erwähnten Bedingungen leuchtet die Anzeige:

- während des Einschalttests im Augenblick des Einschaltens des Oszilloskops
- beim Selbsttest (siehe im Serviceteil dieser Anleitung).

Die LED-Anzeige gibt an:

- Eine Anzahl Ereignisse (Impulse) in Betriebsart EVENTS BEFORE DTB oder MTB; die EV Lampe leuchtet. Mit Steller SET ist jede Zahl zwischen 1 und 99999 wählbar.
- Eine Zeitdauer in Betriebsart DELAY oder ΔT.
  Diese Zeit wird in einer Mantisse mit einem Zehn-Exponenten angezeigt.
  Die maximale angezeigte Zeit in der LED-Anzeige ist gleich der eingestellten Ablenkzeit der Hauptzeitbasis.
- Eine Frequenz (in Betriebsart 1/T) in Mantisse mit einem Zehn-Exponenten.

Andere Anzeigemöglichkeiten:

– *TB OFF*

Zeigt an dass für Horizontalablenkung EXT X DEFL gewählt wurde.

– *ERROR*

Zeigt an dass in Betriebsart EVENTS die Triggerquelle MTB der DTB-Triggerung gewählt wurde.
A, B oder EXT des DTB Triggerung drücken.

– *UNCAL*

In der Anzeige kann das Wort UNCAL zusammen mit Ziffer 1, 2 oder 3 erscheinen.
Die Anzeige UNCAL zeigt dem Benutzer des Geräts an, dass bei diese Einstellung keinen kalibrierte Messung möglich ist.

UNCAL 1 Bedeutet, dass in der Betriebsart DELAY oder ΔT zur DTB Triggerung A, B oder EXT als Quelle gewählt wurden.
MTB-Triggerquelle der DTB Triggerung eindrücken.

UNCAL 2 Gibt an, dass in Betriebsart 1/T der Abstand zwischen den Marken kleiner ist als 0,1 Teil; in diesem Falle ist der in der Anzeige dargestellte Wert nicht mehr genau.
Eine kürzere Einstellung der MTB Ablenkung wählen oder die Zeit mit Hilfe von Knopf SET verlängern.

UNCAL 3 Gibt an, dass in Betriebsart 1/T die Feineinstellung der MTB Ablenkung nicht auf CAL steht.

– *Lampe EV*

Leuchtet wenn in der Anzeige eine Anzahl zu zählender Ereignisse erscheint.

– *Lampe DIV*

Leuchtet wenn in Betriebsart DELAY oder ΔT der Schalter MAIN TB nicht in Stellung CAL ist.
Nun ist in der LED-Anzeige keine Zeit sichtbar sondern statt dessen eine Zahl von Bildschirmteilen.
Lampe S or Hz erlischt dann.

– *Lampe S or Hz*

Leuchtet in Betriebsart DELAY oder ΔT oder 1/T.

– *SET*

Dieser Knopf ermöglicht Einstellung der Verzögerungszeit(en) in Betriebsart DELAY TIME oder ΔT und der Anzahl der zu zählenden Ereignisse in den Betriebsarten EVENTS BEFORE DTB oder EVENTS BEFORE MTB.
Jede Betätigung dieses Knopfes beeinflusst unmittelbar die Daten in der LED-Anzeige.

In der Mittelstellung dieses Knopfes (STOP) bleiben die Daten der LED-Anzeige unverändert.
Rechtsdrehung des Knopfes erhöht und Linksdrehung verringert den Wert in der LED-Anzeige. Je mehr der Knopf von der Mitte weggedreht wird, desto höher ist die Veränderungsrate in der LED-Anzeige.
Durch drücken des Knopfes SET wird die Veränderungsrate um den Faktor 100 erhöht.

Notice d'emploi

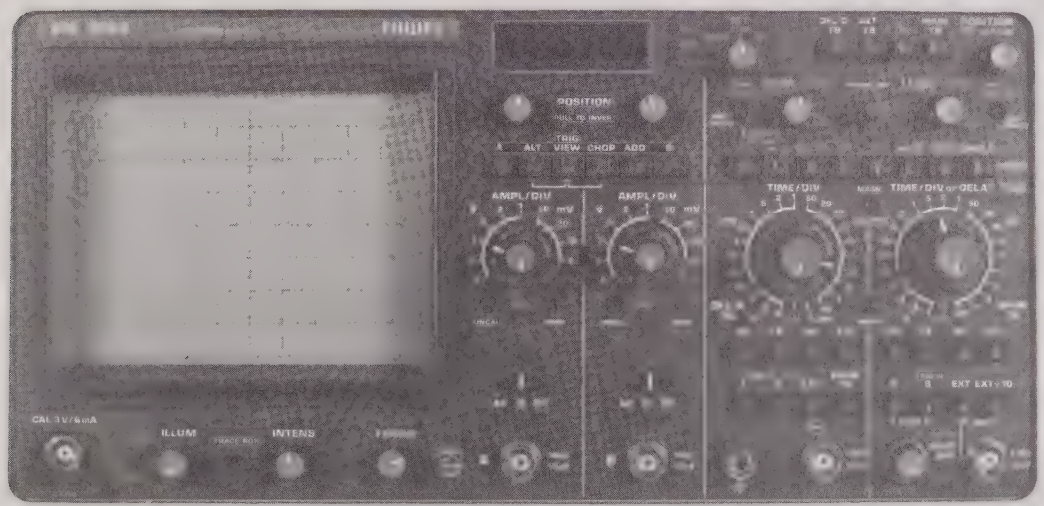
1. GENERALITES

1.1. INTRODUCTION

Le PM 3263 est un oscilloscope portable à deux voies, à haute sensibilité et à large bande, pourvu de possibilités de réglage du temps grâce au microprocesseur incorporé.
Ces possibilités comprennent:

- Double base de temps retardée
- Déclenchement du compteur d'événements pour bases de temps retardée et principale
- Mesures de fréquence

Les résultats des mesures de fréquence et de temps et le nombre sélectionné d'événements à compter sont visualisés sur un affichage LED à 6 chiffres. De plus, l'affichage LED indique ERROR et UNCAL en fonction de l'erreur de manipulation.
Autres possibilités sont: la visualisation du déclenchement, l'affichage de base de temps alternée et le déclenchement TTL automatique.
La base de temps alternée permet l'affichage simultané d'un signal sur deux échelles de base de temps différentes (BTP et BTR).
L'oscilloscope est pourvu de plusieurs circuits intégrés garantissant le fonctionnement stable, ce qui réduit considérablement le nombre de points de réglage.
La tension d'alimentation est réglable sur deux gammes, de 90 V à 140 V et de 180 V à 265 V à l'aide d'un commutateur.
Toutes ces propriétés font du présent oscilloscope un instrument particulièrement utile dans une gamme étendue d'applications.



MAT 196

Oscilloscope PM 3263

1.2. CARACTERISTIQUES TECHNIQUES

Cet appareil a été conçu et testé conformément à la norme C.E.I. 348 pour appareils de classe I. A sa livraison il répond aux règles de sécurité. La présente notice comporte les informations et les avertissements nécessaires à l'utilisateur afin d'assurer le fonctionnement de l'appareil dans les conditions de sécurité et de le maintenir conforme à la norme.
Les spécifications sont valables après que l'appareil a été préchauffé pendant 30 minutes.
Les valeurs exprimées numériquement avec tolérance sont garanties par le fabricant. Les valeurs sans tolérance ne servent qu'à titre d'information et correspondent aux caractéristiques d'un appareil moyen.

Désignation	Spécification	Information supplémentaire
1.2.1. Tube à rayons cathodiques		
– Type	PHILIPS D14-300GH/37	Tube à face rectangulaire, type domed mesh, post-accélérateur, couche phosphore doublée de métal.
Aire de mesure	80 mm x 100 mm	
– Type d'écran	Phosphore P31 (GH)	En option, couche phosphore P7 (GM) ou P11 (BE).
Vitesse d'écriture photographique	> 1500 cm/μs	2000 cm/μs typique. Mesuré avec un appareil photographique Steinheil Oscillophot M5 Ouverture: 1:1,2 Rapport objet image: 1:0,5 Film: Polaroid 410 (10.000 ASA) Pas de prévoilage. Phosphore du type P31 (GH).
Tension d'accélération totale	17 kV	
Graticule	Interne	Illumination continuellement variable.
Gravures	Divisions centimétriques avec subdivisions de 2 mm sur les axes centraux. Les lignes interrompues en 1,5 et 6,5 div. du sommet d'affichage permettent de contrôler le temps de montée.	
– Rotation de trace	Réglage tournevis au panneau avant.	(Trace Rot.)
1.2.2. Axe vertical ou Y		
– Bande passante (gamme 2 mV exceptée)		
Gamme de fréquence	continu à 100 MHz	–3 dB largeur de bande en couplage continu.
	10 Hz ... 100 MHz	–3 dB largeur de bande en couplage alternatif.
		La gamme de fréquence inclut une sonde 10:1 à 20-30 °C.
Temps de montée	3,5 ns	
Dépassement	± 3 % crête-à-crête	Sur 6 divisions, +5 - +40 °C

(Pour spécifications 2 mV/DIV, se référer à la fin du present chapitre)

Désignation	Spécification	Information supplémentaire
– Coefficients de déviation	2 mV/DIV ... 5 V/DIV	En 11 positions étalonnées (progression 1-2-5) avec commande continue non-calibrée 1:⩾ 2,5 par potentiomètre Indication de non-calibrage par lampe.
Erreur limite	± 3 %	
– Tension d'entrée maximale admise	± 400 V	Tension continu et tension alternative crête. Déviant à des fréquences supérieures à 500 kHz. Voir Fig. 1.3.
Déviation maximale sans distorsion	24 divisions	Jusqu'à 35 MHz
Gamme de décalage	16 divisions	8 divisions au-dessus et au-dessous de la ligne horizontale centrale du graticule.
– Impédance d'entrée	1 MOhm ± 2 %//± 15 pF	Entrées A et B également réglées.
Constante de temps RC d'entrée	22 ms	Commutateur de couplage en position AC.
Instabilité de trace	0,1 div./heure	Gamme de température +20 - +40 °C.
Saut de trace	0,2 div.	Lorsque l'on commute l'atténuateur entre deux positions.
Saut de trace	0,5 div.	Lorsqu'on commute NORM/INVERT.
Dérive de trace	0,2 div.	Lorsqu'on tourne l'atténuateur continu. 0,4 div. en gamme 5 mV.
Dérive de trace	1 div.	En poussant le bouton ADDED 0,4 div. en gamme 5 mV. Croissante lorsqu'on tourne l'atténuateur continu.
Dérive de température à long terme	20 μV/°C	Valeur typique. Mesuré à 2 mV à 4 div.
– Retard visible du signal	environ 15 ns	
– Modes d'affichage	Voie + ou – A seulement Voie + ou – B seulement Affichage déclenchement seulement Voies ± A et ± B découpées Voies ± A et ± B alternées Voies ± A et ± B additionnées Affichage déclenchement ± A et ± B découpées ou alternées (affichage 3 voies).	Si l'affichage 3 voies est sélectionné avec l'affichage base de temps alternée l'ensemble est automatiquement affiché en mode de base de temps intensifiée. Si référer à Fig. 1.5.
– Fréquence de commutation	1 MHz	Temps d'affichage par voie: env. 350 ns.
– Diaphonie entre voies	1:500	Jusqu'à 50 MHz.
– Facteur de réjection en mode commun	Supérieur à 100 jusqu'à 2 MHz 20 à 50 MHz	En mode +A et –B additionnées signal max. en mode commun: 8 div.
– Affichage déclenchement		
Affichage	Signal de déclenchement externe ou interne	

Désignation	Spécification	Information supplémentaire
Réponse de fréquence	⩾ 80 MHz	
Coefficient de déviation	Comme verticale	
Externe	100 mV/div. ± 3 %	
Externe ÷ 10	1 V/div. ± 5 %	
Interne	Vertical ± 10 %	
Point du déclenchement	Centre d'écran ± 0,3 div.	Couplage continu.
Aberrations	± 10 % crête-à-crête	
Retard de temps entre entrée verticale et entrée externe	3 ns ± 1 ns	
– Spécification pour réglage 2 mV/div.		
Coefficient de déviation	2 mV/div.	
Erreur limite	± 5 %	
Réponse		
Gamme de fréquence	continu 0 ... 35 MHz alternatif 10 Hz ... 35 Mhz	–3 dB largeur de bande supérieure –3 dB
Temps de montée	10 ns	
Aberration d'impulsion	± 5 % crête-à-crête	
Facteur de réjection en mode commun	Meilleure que 100 jusqu'à 2 MHz	
Instabilité de trace	0,25 div/heure	Gamme de température +20 - +40 °C.
Saut de trace	1 div.	Lorsque l'on commute entre 2 mV/DIV et 5 mV/DIV.
Saut de trace	2 div.	Lorsqu'on actionne le commutateur NORM/INVERT
Dérive de trace	1 div.	Lorsqu'on tourne l'atténuateur continu
Dérive de trace	1 div.	En poussant le bouton ADDED.

1.2.3. Axe horizontal ou X

– Modes de représentation	– Base de temps principale	
	– Base de temps principale intensifiée par base de temps retardée	
	– Base de temps retardée	
	– Base de temps intensifiée et base de temps retardée affichées alternativement.	Séparation de trace de 4 divisions possible.
	– Mode X-Y et X-Y/Y	Déviation X par: – le signal voie A – le signal voie B – le signal appliqué au connecteur EXT de la base de temps principale – la fréquence secteur
Pour base de temps retardée double, se référer à 1.2.6.		
– Dérive horizontale en position x1	0,2 div./heure	La dérive horizontale avec agrandisseur en position x1 ne peut pas excéder 0,1 div/heure dans la gamme de température +20 - +40 °C. La même stabilité est requise au démarrage du balayage dont la vitesse est variée, sauf pour les gammes de balayage supérieure (50-100 ns/div.).

Désignation	Spécification	Information supplémentaire
– Commande de la position horizontal	± 5,2 div. à partir du centre de l'écran	La commande de décadrage horizontal combine le réglage gros et le réglage fin.
1.2.4. Base de temps principale		
– Fonctionnements	Automatique Déclenché Balayage unique	En automatique, la base de temps est en fonctionnement libre en l'absence de signaux de déclenchement après moins de 0,1 s.
– Vitesses de balayage	1 s/div ... 50 ns/div	En 23 positions étalonnées (progression 1-2-5). Commande continue non-étalonnée 1:⩾ 2,5 entre les échelons par potentiomètre. Une lampe indiquant le non-calibrage des deux bases de temps.
– Précision de mesure	± 2 % ± 3 %	Entre +20 °C et +30 °C Entre + 5 °C et +40 °C Différence de précision de balayage pour toutes 2 divisions est de ± 5 % à l'exclusion des premières et dernières divisions sur les positions 5 ns et 10 ns.
– Temps de blocage variable (hold-off)	Le temps de blocage du balayage peut être augmenté par un facteur 10.	Le temps de blocage est minimal en position extrême droite du bouton (CAL). Ce bouton est combiné avec la commande X AMPL.
– Agrandissement	10x	Commuté, étalonné. L'affichage coïncidant à la ligne de graticule horizontale centrale ne peut pas dévier de plus d'une division lors du réglage de l'agrandisseur horizontal sur x10.
Erreur de coefficient	± 1 % supplémentaire	Premières et dernières 50 ns de 5 ns/div., 10 ns/div. et 20 ns/div agrandis ± 5 %.
Coefficient de temps efficace maximal	5 ns/div.	
1.2.5. Base de temps retardée		
– Fonctionnement	Normal	Démarré par MAIN TB ou déclenche (TRIG)
	Double	Démarré par MAIN TB
– Vitesses de balayage	0,5 s/DIV ... 50 ns/DIV	En 22 positions étalonnées (progression 1-2-5). Commande continue non-étalonnée 1:⩾ 2,5 entre les échelons par potentiomètre. Une lampe indiquant le non-calibrage des deux bases de temps.

Désignation	Spécification	Information supplémentaire
Précision de mesure	± 2 % ± 3 %	Entre +20 °C et +30 °C Entre + 5 °C et +40 °C
		Cette précision de balayage, mesurée toutes les deux divisions sur 10 DIV est de 5 %, à l'exclusion des premières et dernières divisions sur les positions 5 ns et 10 ns.
	Agrandissement identique à l'agrandissement de base de temps principale.	
1.2.6. Modes de retard		
– Retard	La base de temps retardée démarre immédiatement après le temps de retard.	L'affichage LED indique le temps de retard.
ou	la base de temps retardée déclenche après le temps de retard.	L'affichage LED indique UNCAL 1.
– ΔT (intervalle)	La base de temps retardée démarre alternativement après le premier et le second retard.	L'affichage LED indique l'intervalle de temps de retard.
1/T	Temps d'intervalle ou de retard.	L'affichage LED indique la valeur inversée du temps d'intervalle ou de retard.
– Evénements avant BTR	La base de temps retardée est déclenchée après le comptage d'un certain nombre d'événements.	L'affichage LED indique le nombre sélectionné d'événements.
– Evénements avant BTP	La base de temps principale est déclenchée après le comptage d'un certain nombre d'événements.	L'affichage LED indique le nombre sélectionné d'événements.
– Evénements avant BTP combiné avec retard ΔT ou 1/T	La base de temps principale est déclenchée après le comptage d'un certain nombre d'événements	L'affichage LED indique la valeur correspondant à la dernière fonction sélectionnée. Les fonctions et valeurs précédentes sont mises en mémoire. Le déclenchement de la base de temps retardée n'est pas possible.
Retard, ΔT , 1/T	Variable entre 0X et 10X le coefficient de temps de BTP.	L'affichage LED indique la valeur digits avec exposant de dix. Le retard est lu en secondes ou, si la commande continue BTP n'est pas en position CAL, en divisions. Si la BTR est déclenchée, l'affichage LED indique UNCAL 1.
Résolution du réglage	5.10^{-4} de 10x réglage BTP	Commande continue BTP en position CAL. Commande continue BTP pas en position CAL: 0,05 mm.
Jitter	1 : 30.000	

Désignation	Spécification	Information supplémentaire

Accuracy

Delay	ΔT	1/T
± 1 % d'échelle	± 1 % de l'indication	± 1 % de l'indication
– A °/oo d'échelle	– A °/oo d'échelle	– A °/oo d'échelle*
+ retard initial: 20 ns	± 0,25 °/oo d'échelle	± 0,25 °/oo d'échelle

* A dépend du réglage MTB Time/Div.
A = 1,5 aux positions commençant avec 5
A = 0,5 aux positions commençant avec 1
A = 0 aux positions commençant avec 2

Erreur supplémentaire à positions 50 ns/div et 100 ns/div de MTB: ± 3 % et ± 1 % respectivement.

Stabilité à long term

2 div. à 1000x

Rapport entre balayage BTP et BTR 1000.

ΔT

Variable entre 0x et 10x le coefficient de temps de la BTP.

Le temps (ΔT) entre les deux BTR's est indiqué à l'affichage LED à 4 (ou 3) digits avec exposant.

Le retard est lu en secondes ou, si la commande continue BTP n'est pas en position CAL, en divisions.

Le second balayage retardé ne peut être réglé avant le premier.

Si la somme du temps de retard et ΔT excède le temps de balayage BTP total, le second balayage retardé ne dépassera pas le balayage BTP, mais il se maintiendra à la fin de ce balayage. La valeur reéele de ΔT est mise en mémoire. Donc, si le temps de retard est diminué de telle sorte que retard et temps ΔT sont inférieurs au temps de balayage BTP, le second balayage retardé quittera à nouveau sa position en fin du balayage BTP.

1/T

L'affichage LED indique la valeur inversée du temps de retard ou du temps ΔT.

1/T est lu en Hz à 4 digits avec exposant de dix.

Si la commande continue BTP n'est pas en position CAL, l'affichage LED indique UNCAL 3.

Distance minimale entre marqueurs: 0,1 div.
1 div.

x1
Agrandissement x10.

Si la distance est plus petit l'affichage LED indique UNCAL 2.

Désignation	Spécification	Information supplémentaire
Evénements avant BTR	Le nombre d'événements peut être réglé entre 0 et 99999.	Le nombre d'événements est continûment réglable par potentiomètre SET. La vitesse du compteur est proportionelle à l'angle de rotation du potentiomètre et variable entre 1 et 50 impulsions par seconde. En position enfoncée, une variation entre 100 et 5000 impulsions par seconde est possible. Si le nombre d'impulsions réglées avec le potentiomètre est supérieur au nombre affiché pour un balayage BTP unique, NOT TRIG de BTR s'allume. Si, en mode "événements", la source de déclenchement MAIN TB est sélectionnée, l'affichage LED affiche ERROR.
Evénements avant BTP	Pour nombres d'événements conditions d'impulsions, temps de préparation, etc. voir "événement avant BTR". Evénements avant BTP peut être combinée avec retard, ΔT ou 1/T.	Le déclenchement BTP sert à mettre le compteur en service, tandis que les impulsions à compter sont délivrées par déclenchement BTR.
Conditions d'impulsion	Taux d'événements maxi 125 MHz Largeur d'impulsion mini 4 ns Espace d'impulsion mini 4 ns	
Temps de préparation	Référer à la Fig. 1.2.	

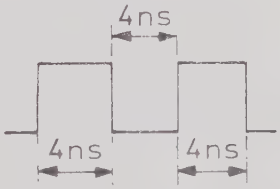


Fig. 1.1. Taux d'événements maxi 125 MHz.

1.2.7. Déviation X par YA ou YB

	2 mV/Div à 5 V/Div.	Commande continue non-étalonnée 1:≥2,5.
Erreur de mesure	± 5 %	
Bande passante	0 ... 2 MHz	–3 dB sur 8 DIV.
Déviation maxi sans distortion	20 divisions	Jusqu'à 0,1 MHz
Déphasage par rapport à l'affichage Y	3° à 0,1 MHz	

1.2.8. Déviation externe X par douille EXT

– Coefficient de déviation

Ext.:1	50 mV/div.	Commande continue non-étalonnée 1:3 avec X AMPL; étalonnée en position extrême droite (CAL).
Ext.:10	500 mV/div	
Précision Ext.:1	± 3 %	2% supplémentaire pour Ext.:10
Bande passante	Continu .... 2 MHz 7 Hz .... 2 MHz	Par couplage de déclenchement DC Par couplage de déclenchement LF ou HF.
Caractéristiques d'entrée	Mêmes que pour voies Y	
Déphasage	3° à 0,1 MHz	En comparaison de voies Y.
Linéarité	1,5 %	
Dérive	0,2 div/heure	

	Désignation	Spécification	Information supplémentaire
1.2.9.	**Déclenchement de la base de temps principale**		
	Source	Interne à partir de la voie A Interne à partir de la voie B Composite A et B Intern à partir du secteur Source externe Source externe ÷ 10	Mode vertical alterné uniquement
	Modes	Automatique	Fonctionnement automatique du générateur de base de temps environ 100 ms après la disparation du signal de déclenchement.
		Déclenchement	
		Balayage simple	
	Témoin NOT TRIG'D	Indique que la base de temps principale n'est pas déclenchée. La lampe NOT TRIG'D est allumée après remise et s'éteint en fin de balayage.	
	Polarité	+ ou −	
	Sensibilité	Interne, meilleur que: 0,5 div. jusqu'à 30 MHz 1,5 div. jusqu'à 100 MHz 2 div. jusqu'à 150 MHz	Sensibilité typique en fonction de la fréquence, voir Fig. 1.4.
		Externe: 50 mV jusqu'à 30 MHz 150 mV jusqu'à 100 MHz 200 mV jusqu'à 150 MHz	
		Externe ÷ 10: Typique, values 10 fois supérieures par rapport à la position EXT.	
	Modes de déclenchement et couplage	DC: bande totale	Réponse uniforme, en interne et en externe
		LF interne: 0 - 30 kHz	−3 dB
		LF externe: 7 Hz - 30 kHz	−3 dB
		HF: 30 kHz - 100 MHz	−3 dB, interne et externe
		TTL	Déclenchement automatique TTL; commande de niveau ne fonctionne pas.
	TTL niveaux	Déclenchement interne (A, B ou Comp.) Bas : 0,8 div (± 0,4 div) Haut : 2 div (± 0,4 div) Ecart: 1,2 div	
		Déclenchement externe (EXT) Bas : +0,8 V (± 0,4 V) Haut : +2 V (± 0,4 V) Ecart : 1,2 V	Ces données s'appliquent aux tensions à la pointe de la sonde atténuatrice 1:10 connectée à la douille d'entrée EXT.
	Gamme de niveau	Déclenchement : 24 div. Déclenchement externe : +1,2 V à −1,2 V Externe ÷ 10 : +12 V à −12 V	
	Caractéristique d'entrée	Mêmes que pour voies Y.	
	Instabilité de déclenchement	< 0,5 ns.	

Désignation	Spécification	Information supplémentaire
1.2.10. Déclenchement de la base de temps retardée		
Source	Interne à partir de la voie A Interne à partir de la voie B Externe Base de temps principale	Les autres données sont identique à celles de la déclenchement de la base de temps principale; excepter EXT ÷10 et LINE trig.
Témoin NOT TRIG'D	Indique que la base de temps rétardée n'est pas déclenchée.	
1.2.11. Sortie d'étalonnage		
Tension	3 V_{cc}	
Courant	6 mA	Par bouche de courant
Erreur limite	± 1 %	
Frequence	2 kHz ± 2 %	
Protection	La sortie est protegée contre des courts-circuits même continus.	
1.2.12. Entrées/sorties supplémentaires		
Modulation Z	Couplé en continu Compatible TTL Temps de réponse 35 ns Impédance d'entrée 10 kΩ Tension maximale d'entrée 50 V	Haut niveau donne un affichage sombre
Porte base de temps principale	+5 V délivrée pendent le balayage de base de temps principale autrement "0".	Impédance de sortie 1 kΩ
Porte de base de temps retardée	+5 V délivrée pendant le balayage de base de temps retardée autrement "0".	Impédance de sortie 1 kΩ
1.2.13. Alimentation		
Tensions secteur	100-127 V alternatif ± 10 % 220-240 V alternatif ± 10 % 250 V continu - 350 V continu	Protégé automatiquement contre le réglage incorrect du sélecteur secteur. La position du sélecteur n'importe pas.
Fréquence secteur	46 à 440 Hz	
Consommation	60 W	
Fusible secteur incorporé	2 A retardée	Sur le panneau arrière.
Transitoire secteur	Dans des conditions de transitoire tension et fréquence spécifiée dans MIL-T-28800, l'oscilloscope ne subira aucun dommage.	

Désignation	Spécification	Information supplémentaire

1.2.14. Conditions ambiantes

Les données relatives aux conditions ambiantes ne sont valables que si l'instrument est contrôlé conformément aux méthodes officielles. Des renseignements sur ces methodes et sur les critères employés sont fournis sur demande par l'organisation Philips de votre pays ou par le TEST AND MEASURING DEPARTMENT de la N.V. PHILIPS' GLOEILAMPENFABRIEKEN à EINDHOVEN, PAYS-BAS.

– *Tests de température*

Conformément à C.E.I. 68 Ab et Bb.
Gamme limite d'utilisation: −15 °C ... +55 °C. Les exceptions au tolérances sont indiquées par spécification.
Gamme limite d'utilisation: −15 °C ... +55 °C.
Conditions de stockage de transport: −55 °C ... +75 °C.

– *Altitude*

Conformément à C.E.I. 68-2-13, test M.
En fonctionnement: 5000 m;
Déviation: 1 °C/300 m pour température maximale.
Hors fonctionnement: 17000 m.

– *Humidité*

Conforme à C.E.I. 68 Db, selon le test standard d'oscilloscope Philips. Une comparaison doit être faite avec MIL-E-1640F 5 cycles (120 heures).

– *Chocs*

En fonctionnement: 30 g, demi-sinus, durée 11 ms; 2 chocs par axe dans chaque direction, total 12 chocs.

– *Vibration*

En fonctionnement: 15 min. dans chacune des trois directions.
0,7 mm déplacement crête-à-crête (4 g à 55 Hz) à fréquence 10 Hz - 55 Hz - 10 Hz en cycles d'une minute.

– *Temps de rétablissement*

30 minutes si la température de l'instrument passe de −10 °C à +20 °C sous humidité relative de 60 %.

– *Blindage magnétique*

Conformément à C.E.I. 351-22.3.1.
Déviation maxi: 1 div.

– *Interférence électromagnetique*

Conformément à VDE 0871 et 0875, Störgrad K.

1.2.15. Caractéristiques méchaniques

Dimensions	Longueur	460 mm	Commandes, couvercle et pieds non compris.
	Largeur	316 mm	
	Hauteur	154 mm	
Poids	10,7 kg.		

1.3. ACCESSOIRES

1.3.1. Accessoires livrés avec l'appareil

- Deux sondes passives 10:1
- Filtre de contraste
- Couvercle frontal avec emplacement pour accessoires
- Visière pliante PM 9366
- Adaptateur BNC banane (PM 9051)
- Borne CAL - Adaptateur BNC
- Notice d'emploi et d'entretien

1.3.2. Accessoires en option

PM 8921	Sonde 1:1, câble 1,5 m	**PM 9346**	Alimentation de sonde
PM 8921L	Sonde 1:1, câble 2,5 m	**PM 8960**	Jeu pour montage en rack 19"
PM 8935	HF sonde 10:1, cable 1,5 m	**PM 8992**	Sacoche pour accessoires
PM 8935L	HF sonde 10:1, câble 2,5 m	**PM 9380**	Appareil de photographie d'oscillogrammes
PM 8932	Sonde 100:1		
PM 8940	Amplificateur isolé	**PM 8971**	Adaptateur de camera pour PM 9380
PM 8943	Sonde FET 1:1. 10:1, 100:1	**PM 8910**	Filtre Polaroid
PM 8994	Jeu d'accessoires pour sondes	**PM 8901**	Jeu de batteries 24 V continu et 280 V continu
PM 9355	Sonde de courant 1 mA/div ... 1A/div; 12 Hz ... 70 MHz	**PM 8991**	Chariot

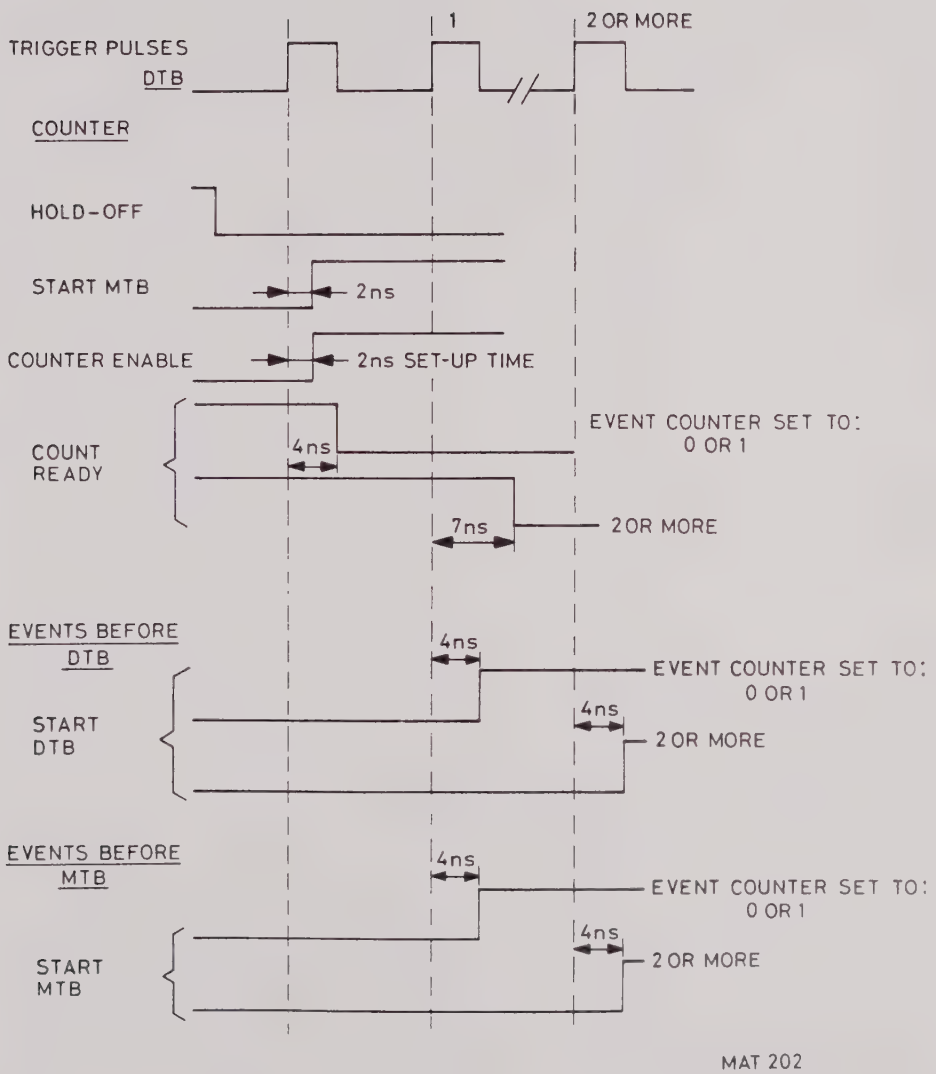


Fig. 1.2. Temps de préparation.

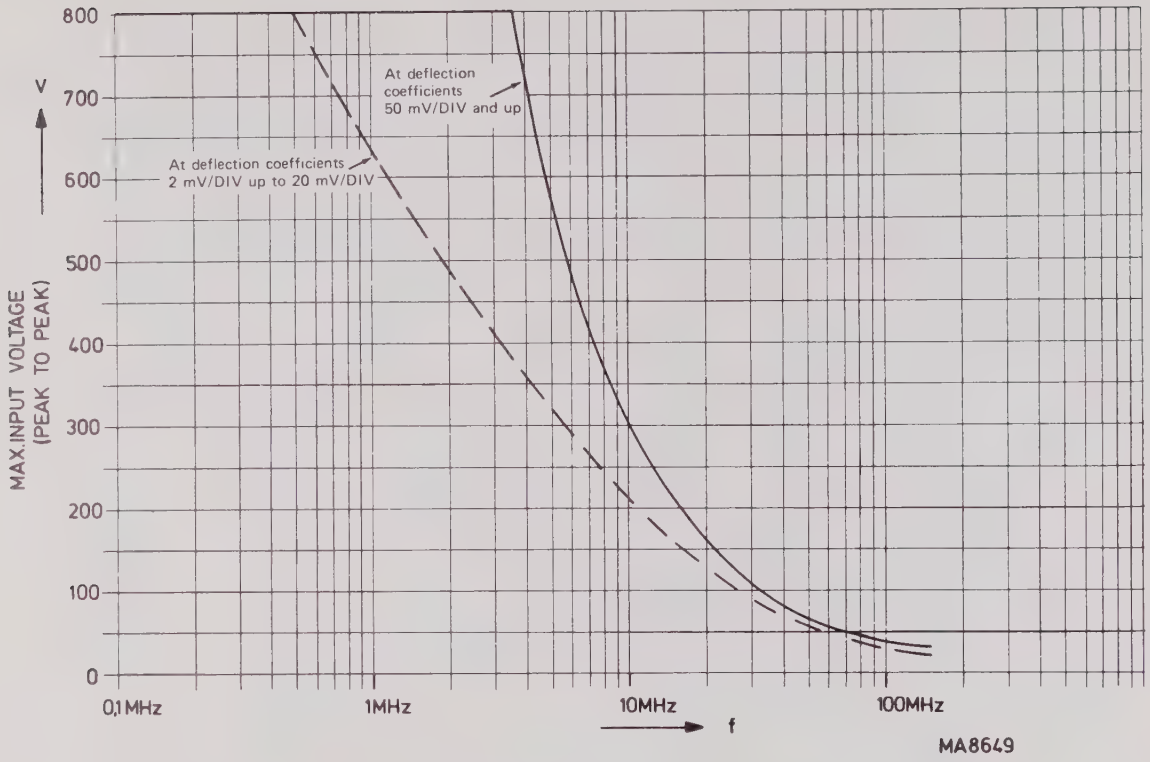


Fig. 1.3. *Réduction de la tension d'entrée maximale admise*

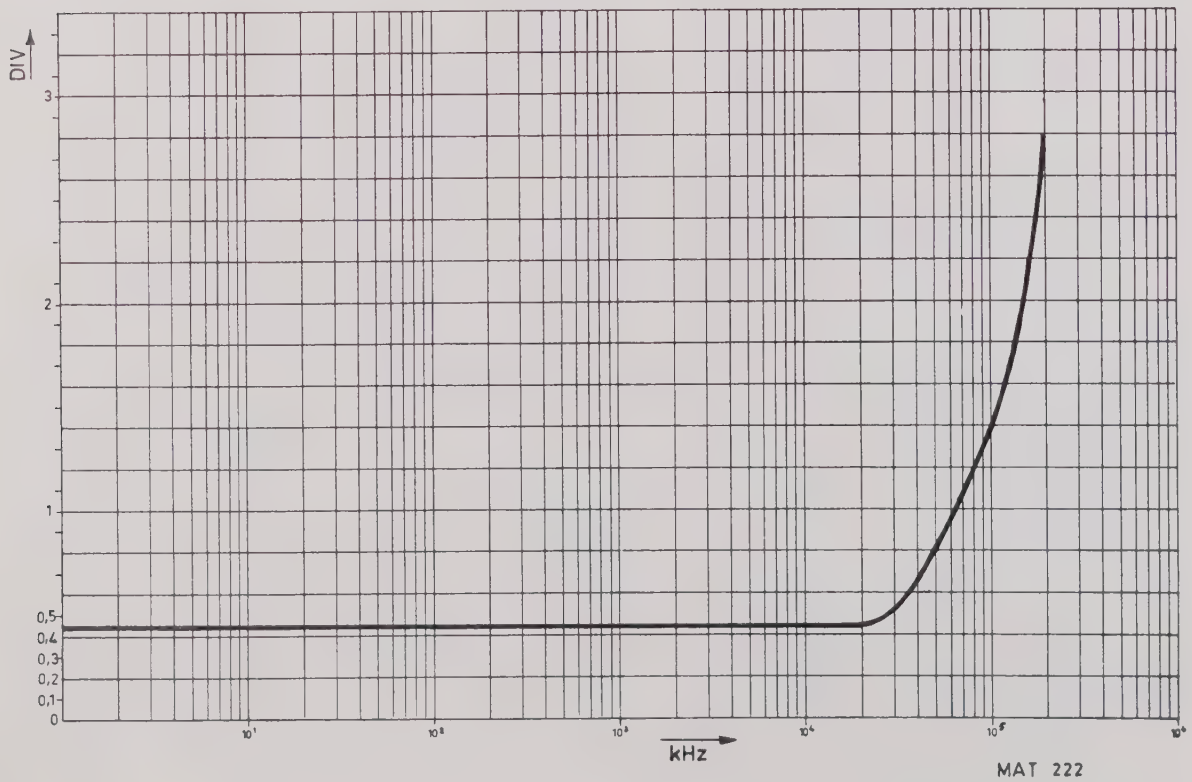
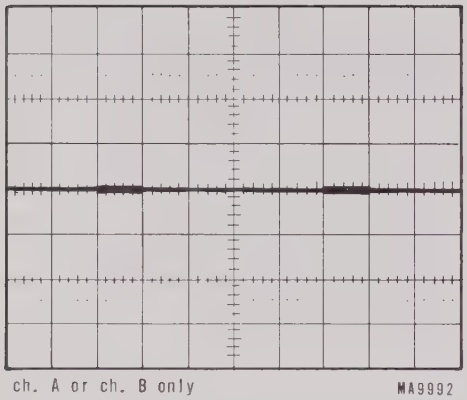
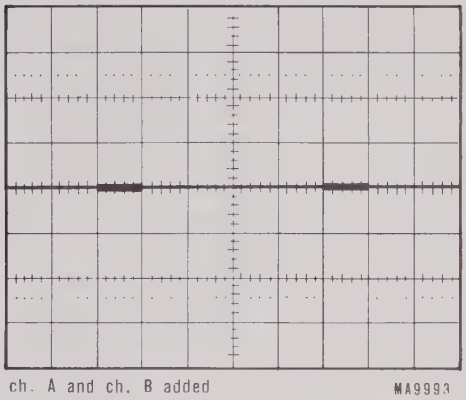
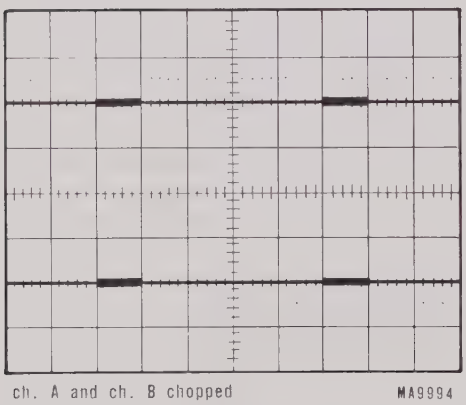


Fig. 1.4. Sensibilités typiques pour déclenchement interne de la voie A.

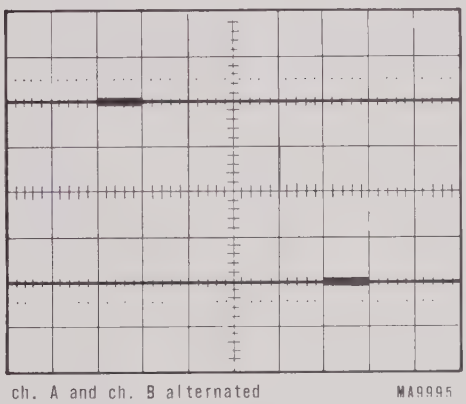




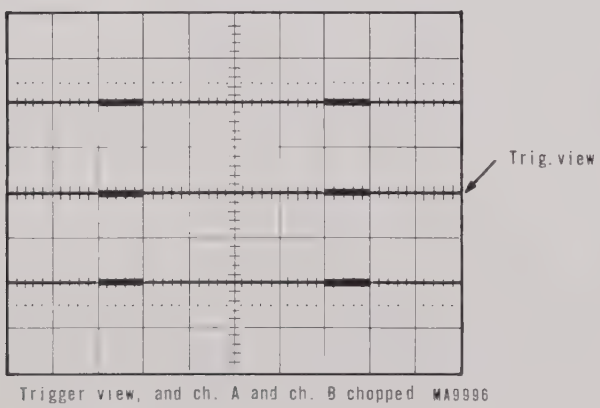
Voies A et B additionnées



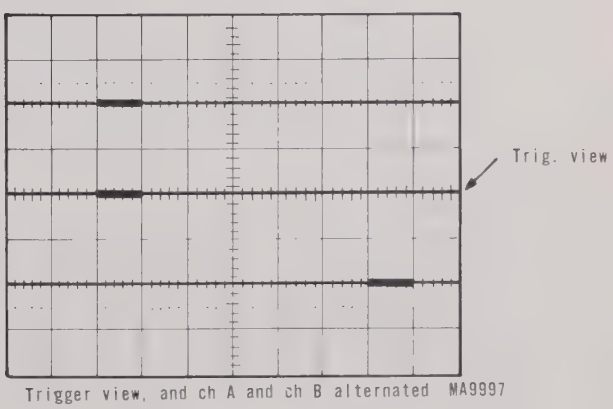
Voies A et B commutées



Voies A et B alternées



Voies A, B et Trigger view commutées



Voies A, B et Trigger view alternées

Fig. 1.5. Sommaire des possibilités d'affichage avec la base de temps retardée double.

2. MODE D'EMPLOI

2.1. GENERALITES

La présente section décrit les travaux et précautions requises à l'installation du PM 3263. De plus, elle décrit en bref les fonctions des commandes et indicateurs, et met en évidence les aspects pratiques du fonctionnement. De la sorte, un opérateur peut rapidement se familiariser avec les fonctions principales de l'appareil.

2.1.1. Adaptation à la tension secteur et fusible

Placer le commutateur d'adaptation de la tension secteur dans la position correspondante. Ce commutateur est localisé à l'arrière du panneau arrière.
Le porte-fusible monté sur le panneau arrière porte un fusible à action retardée de 2 A. S'assurer que des fusibles correctement calibrés et du modèle convenable sont utilisés en cas de remplacement. Il faut éviter d'utiliser des fusibles réparés et de court-circuiter des porte-fusiles. En cas de remplacement d'un fusible l'appareil doit être débranché de toutes sources de tension.

2.1.2. Mise à la terre

Avant toute mise sous tension, l'appareil doit être connecté à la terre de l'une des manieres suivantes:

- Par la borne de terre de l'appareil (symbole ⏚).
- Par le cordon secteur à trois conducteurs.

La fiche secteur ne doit être introduite que dans une prise possédant un contact de terre. La mise à la terre ne doit pas être éliminée par l'emploi d'un câble prolongateur sans conducteur de terre.
A l'usage d'un appareil à terre flottante, veiller à ce que le coffret complet porte la tension à laquelle la borne de terre de la sonde est connectée.
Le remplacement d'une fiche secteur se fait aux risques et périls de l'utilisateur.

ATTENTION: Toute interruption de la ligne de terre, à l'intérieur ou à l'extérieur de l'appareil ou le débranchement de la borne de terre peuvent rendre l'appareil dangereux. L'interruption intentionnelle est formellement interdite.
Lorsqu'un appareil passe d'un endroit froid à un endroit chaud, la condensation peut provoquer un certain risque. En conséquence, il faut appliquer strictement les prescriptions de mise à la terre.

2.1.3. Installation

Avant de procéder à toute autre connexion, la borne de terre de l'appareil doit être reliée à la ligne de terre du réseau (voir mise à la terre).

REMARQUE: L'ouverture des capots ou la dépose d'organes, à l'exception de ceux directement accessibles à la main sont susceptibles de mettre à jour des composants et des connecteurs sous tension. L'appareil doit être débranché de toute source de tension avant de procéder à un réglage, un remplacement, une opération d'entretien ou une réparation demandant l'ouverture de l'appareil. Au cas où le réglage, l'entretien ou la réparation de l'appareil ouvert sous tension sont inévitables, seule une personne qualifiée peut se charger de cette tâche.
Ne pas oublier que les condensateurs à l'intérieur de l'appareil peuvent être chargés, même si l'appareil est déconnecté de toute source de tension.

2.1.4. Poignée

Pour faire pivoter la poignée, il faut enfoncer les boutons-poussoirs aux étriers.

2.1.5. **Couvercle frontal** (voir Fig. 2.1.)

Démontage:
- Tourner le bouton au centre du couvercle d'un quart de tour vers la gauche (position UNLOCKED).
- Enlever le couvercle.

Montage :
- Tourner le bouton de verrouillage vers position UNLOCKED.
- Fixer le couvercle sur la partie avant de l'oscilloscope.
- Enfoncer le bouton et le tourner d'un quart de tour vers la droite (position LOCKED).

L'espace creux dans le couvercle avant permet d'y placer des accessoires tels que sondes, visière, etc.
Pour ouvrir le couvercle, presser les langues de verrouillage et soulever le panneau intérieur.

2.1.6. Enclenchement

Le commutateur POWER est incorporé dans la commande d'illumination de graticule ILLUM (panneau avant), juste sous le bord de l'écran. La lampe POWER ON/OFF est adjacente à la commande ILLUM.
L'oscilloscope ne doit jamais être enclenché lorsqu'un platine ou un bloc a été enlevé. Ne déposer de platine ou de bloc qu'une minute au moins après la mise hors service de l'oscilloscope.

2.1.7. Test initial ("power-on")

A la mise en circuit, le microprocesseur démarre un test automatique des circuits interne y compris:

- test processeur
- test prom
- test ram
- test affichage

Le résultat de ces tests est indiqué sur l'affichage LED.
Un ⊟ . apparaît de gauche à droite à chaque digit pendant 0,5 sec.
Ensuite, les témoins EV, DIV et S ou Hz s'allument pendant 0,5 sec.
Si les circuit contrôlés par le microprocesseur ne fonctionnent pas proprement, les résultats suivants sont indiqués sur l'affichage LED:

- L'affichage reste vierge:
  test processeur négatif
- ⊡ en position extrême droite:
  test prom négatif
- / en position extrême droite:
  test ram négatif

2.2. DESCRIPTION DES COMMANDES ET CONTROLES

2.2.1. Déviation verticale et section TRC

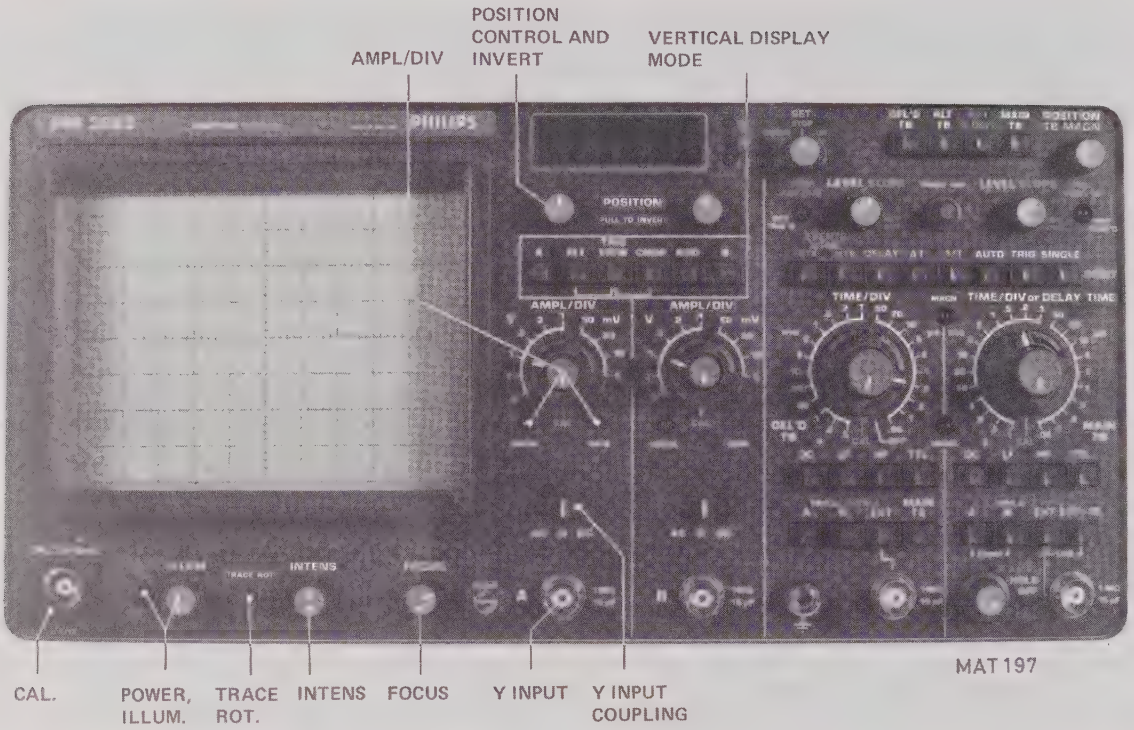


Fig. 2.1. Deviation verticale et section TRC

— Mode d'affichage vertical	Commandes du mode d'affichage vertical, sélecteur à 6 boutons-poussoirs.
poussoir A enfoncé	La déviation verticale est obtenue seulement par le signal appliqué à l'entrée de la voie A.
poussoir ALT enfoncé	L'affichage est permuté d'une voie vertical à l'autre, et ce à la fin de chaque cycle du signal de base de temps; les voies A et B sont représentées sur les balayages ALT.
poussoir TRIG VIEW enfoncé	L'affichage est commuté pour visualiser le signal de déclenchement sélectionné. Il peut être interne par les voies A ou B ou externe. L'affichage Trig View peut être combiné avec l'affichage ALT ou CHOP.
poussoir CHOP enfoncé	L'affichage est permuté d'une voie verticale à l'autre à une fréquence fixe, les deux voies étant affichées sur le même balayage.
poussoir ADD enfoncé	La déviation verticale est obtenue par la somme des signaux A et B.
poussoir B enfoncé	La déviation verticale est obtenue seulement par le signal appliqué à l'entrée de la voie B.
poussoirs ALT et TRIG VIEW enfoncés simultanément	Les signaux sur voies A, B et TRIG VIEW sont affichés pendant les balayages alternés; normalement appropriés pour des signaux haute fréquence. (voir aussi explication bouton-poussoir TRIG VIEW).
poussoirs CHOP et TRIG VIEW enfoncées simultanément	Les signaux sur voies A, B et TRIG VIEW sont affichés successivement à la fréquence CHOP pendant le même balayage normalement appropriés pour des signaux basse fréquence. (voir aussi explication bouton-poussoir TRIG VIEW).
Tous les poussoirs relâchés	Si aucun bouton-poussoir n'est enfoncé, l'appareil fonctionne en mode ALT.

POSITION	Commande continûment variable pour décadrage vertical de l'affichage.
PULL TO INVERT	Commutateur tirette intégré à la commande POSITION, pour inversion de la polarité du signal. La polarité est inversé en position tirée.
AMPL/DIV	Commande échelonné à 11 positions des coefficients de déviation verticale. En position 2 mV/DIV, la largeur de bande est limitée à 35 MHz.
CAL (AMPL/DIV)	Commande continuellement variable des coefficients de déviation verticale. En position CAL le coefficient de déviation est étalonné.
UNCAL	Lampe témoin indiquant que la commande CAL n'est pas en position étalonnée.
GAIN (accessible par tournevis)	Commande continuellement variable du gain en position CAL.
— Couplage d'entrée Y	
AC, 0, DC	Mode de couplage du signal d'entrée; commutateur à trois positions.
AC	Couplage par l'intermédiaire d'un condensateur de liaison.
0	La connexion entre l'entrée de l'amplificateur et la prise d'entrée est interrompue et l'entrée de l'amplificateur est mise à la terre.
DC	Couplage direct.
— Entree	
A 1 MOhm - 15 pF	Prise d'entrée BNC pour voie A
B 1 MOhm - 15 pF	Prise d'entrée BNC pour voie B
— Section TRC	
CAL	Sortie délivrant une tension rectangulaire 3 V_{CC}, 2 kHz pour étalonner la commande AMPL de déviation vertical ou pour compenser la fréquence des sondes du diviseur de tension. Boucle de courant avec 6 mA_{CC} pour l'étalonnage des sondes de courant.
ILLUM, POWER ON	Commande continuellement variable de l'illumination de graticule; comprend le commutateur secteur.
POWER ON	Lampe témoin indiquant que l'appareil est branché au secteur.
TRACE ROT (accessible par tournevis)	Commande de pré-réglage pour aligner la trace avec les lignes de graticule.
INTENS	Commande continuellement variable pour la brillance de la trace.
FOCUS	Commande continuellement variable pour la focalisation du faisceau.

2.2.2. Déviation horizontale

Fig. 2.2. Deviation horizontale

– Mode d'affichage horizontal	Commandes du mode d'affichage horizontal; par commutateur à 4 boutons-poussoirs.
poussoir DEL'D TB enfoncé	La déviation horizontale est fournie par le générateur de base de temps retardée.
poussoir ALT TB enfoncé	L'affichage horizontal est permuté de la base de temps principale en base de temps retardée à la fin de chaque cycle, etc. Quand ALT TB est combiné avec TRIG VIEW, l'affichage MAIN TB est présenté.
poussoir EXT X DEFL enfoncé	La déviation horizontale peut être obtenue par un signal d'origine extérieure appliqué à la prise d'entrée de l'amplificateur horizontal, par le signal de voie A, par le signal de voie B ou par un signal à la fréquence du secteur, en fonction de la sélection TRIG ou X DEFL.
poussoir MAIN TB enfoncé	La tension de déviation horizontale est fournie par le générateur de base de temps principale. Une partie de la trace est intensifiée (sauf en position OFF du commutateur TIME/DIV du générateur de base de temps retardée).
Si aucun bouton n'est enfoncé	On obtient le même effet que lorsque le bouton MAIN TB est enfoncé.
POSITION TB MAGN	Commande continuellement variable pour le positionnement horizontal des traces; cette commande comprend un commutateur push-pull qui augmente le coefficient de déviation horizontale d'un facteur 10 (PULL FOR X10).

TRACE SEP	Commande de pré-réglage continûment variable de l'espace vertical entre les deux affichages de base de temps en mode ALT TB.
– Sélecteur de déviation	Sélecteur de déviation externe X ou sélecteur de source de déclenchement BTP. La déviation X uniquement lorsque le bouton EXT X DEFL du sélecteur d'affichage horizontal est enfoncé.
A enfoncé	Déviation X interne de la voie A.
B enfoncé	Déviation X interne de la voie B.
EXT enfoncé	Le signal à l'entrée externe est utilisé à la déviation X.
EXT ÷ 10 enfoncé	Identique au précédent à la difference que le signal passe par un diviseur de tension incorporé 1:10.
LINE (EXT et EXT÷10 enfoncé)	Déviation X interne de la tension réseau.
– EXT DEFL INPUT	Douille d'entrée pour déviation X externe.
– X AMPL	Commande variable de l'amplitude de déviation X en mode EXT X DEFL combiné avec la commande de blocage. Normalement ce bouton est en position CAL.

2.2.3. Base de temps principale

Fig. 2.3. Base de temps principale

TB MAGN

Commutateur push-pull pour augmenter le coefficient de déviation horizontale d'un facteur 10 (PULL FOR X10).

LEVEL SLOPE

Commande continuellement variable pour sélectionner le niveau du signal de déclenchement, auquel le générateur de base de temps principale démarre. Cette commande comprend un commutateur push-pull, qui permet de déclencher sur le front positif ou négatif du signal de déclenchement (enfoncé "+", tiré "–").

NOT TRIG'D

Lampe témoin qui s'allume lorsque le générateur de base de temps principale est en position d'attente.

– AUTO, TRIG, SINGLE

Commande de mode de déclenchement; commutateur à trois boutons-poussoirs.

poussoir AUTO enfoncé

Le générateur de base de temps principale est en fonctionnement libre en l'absence de signaux de déclenchement.

poussoir TRIG enfoncé

Le générateur de base de temps est déclencé normalement.

poussoir SINGLE (RESET) enfoncé

Le générateur BTP, est en mode de balayage simple. A la réception d'une impulsion de déclenchement, le générateur ne démarre qu'une seule fois.
Si on enfonce une nouvelle fois ce bouton, la BTP est remise à zéro en vue de l'impulsion de déclenchement suivante.
Si aucun bouton n'est enfoncé, l'appareil fonctionne en mode SINGLE.

– MAGN

Une lampe témoin indiquée x10 s'allume lorsque cette loupe est utilisée; pour bases de temps principale et retardée.

– TIME/DIV	Commande de la vitesse de balayage de la base de temps principale; commutateur rotatif à 23 positions.
CAL (blue) (TIME/DIV)	Commande continuellement variable de la vitesse de balayage de la base de temps principale. En position CAL, la vitesse de balayage est étalonnées).
UNCAL	Lampe témoin indiquant que la commande CAL n'est pas en position étalonnée; pour BTP et BTR.
– COUPLAGE DE DECLENCHEMENT	Commutateur 4 voies (type bouton-poussoir)
DC	Pleine largeur de bande (continu compris).
LF	Couplage par le filtre passe-bas pour des fréquences allant de continu jusqu'à 30 kHz (de 7 Hz à 30 kHz pour déclenchement externe, par filtre passe-bande).
HF	Couplage par un filtre passe-haut pour des fréquences supérieures à 30 kHz.
TTL	Déclenchement automatique aux niveau TTL. Commande de réglage continuellement de niveau hors de service.

Si aucun bouton-poussoir n'est enfoncé, on obtient le même effet que si la touche DC était enfoncée.

TRIG SELECTOR	Bouton-poussoir à 4 voies.
Sélecteur de déclenchement	Sélecteur de déclenchement externe X ou sélecteur de source de déclenchement BTP. La déviation X uniquement lorsque le bouton EXT X DEFL du sélecteur d'affichage horizontal est enfoncé.
A enfoncé	Déclenchement X interne de la voie A.
B enfoncé	Déclenchement X interne de la voie B
COMP (A et B enfoncés)	Déclenchement X interne des voies A et B; seulement dans le mode Y alternative.
EXT enfoncé	Déclenchement sur signal externe par douille d'entrée adjacente.
EXT÷10 enfoncé	Identique au précédant à la différence que le signal passe par un diviseur de tension incorporé 1:10.
LINE (EXT et EXT÷10 enfoncés)	Déclenchement X interne de la tension réseau.

Si aucun bouton n'est enfoncé, le circuit fonctionne comme si le bouton A était enfoncé.

EXT TRIG INPUT	Entrée pour déclenchement externe.
HOLD OFF	Ce bouton permet de commander le temps de blocage de la BTP et donc le déclenchement parfait par exemple sur des signaux à double impulsion. Normalement ce bouton est en position CAL. Au plus on l'éloigne de cette position, au plus le temps de blocage augmente. Combiné avec le bouton X AMPL variable.

2.2.4. Base de temps retardée

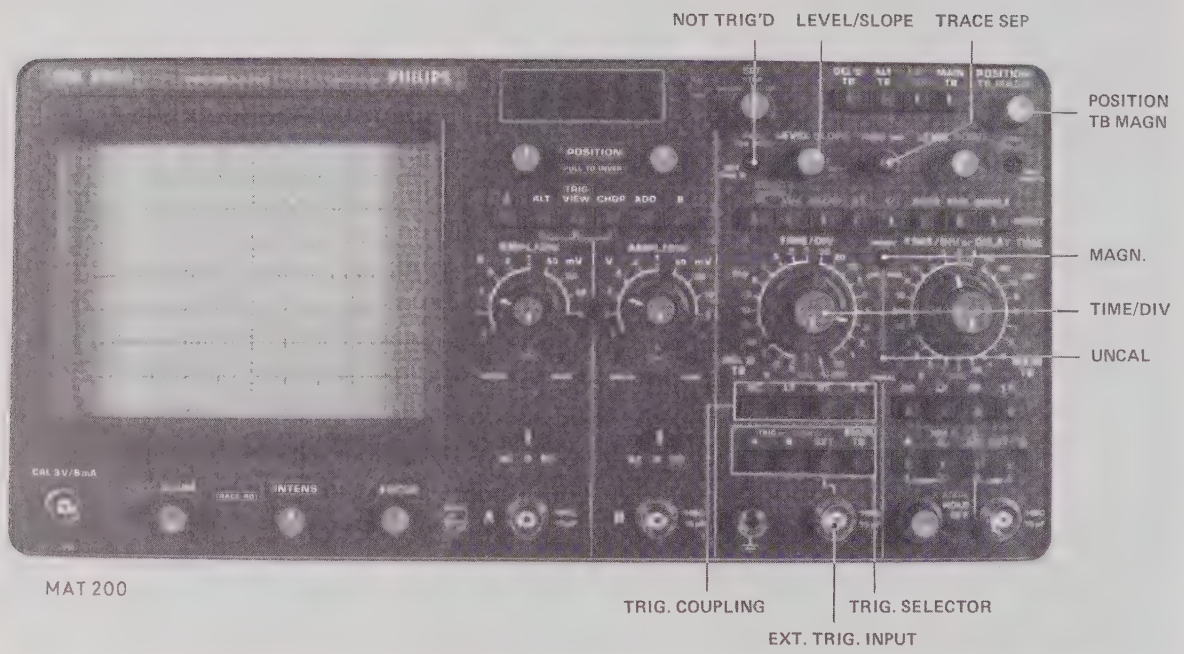


Fig. 2.4. Base de temps retardée.

POSITION TB MAGN	Commande continuellement variable pour le positionnement horizontal des traces comprend un cummutateur push-pull qui augmente le coefficient de déviation horizontale d'un facteur 10 (PULL FOR X10).
TRACE SEP	Commande continûment variable de séparation entre les deux affichages de base de temps en mode ALT TB.
LEVEL-SLOPE	Commande continuellement variable qui permet de sélectionner le niveau du signal de déclenchement auquel le générateur de base de temps retardée démarre. Cette commande comprend un commutateur push-pull qui permet de démarrer sur le front positif ou négatif du signal de déclenchement ("+"enfoncé, "–" tiré).
NOT TRIG'D	Témoin indiquant que le générateur BTP est en position d'attente.
MAGN	Témoin X10 indiquant que cette loupe est utilisée (pour BTP et BTR).
TIME/DIV	Commande du coefficient de temps pour base de temps retardée; commutateur rotatif à 23 positions. Comprend une position OFF, grâce à laquelle le générateur de base de temps retardée est déclenché.
CAL (bleu) (TIME/DIV)	Commande continuellement variable du coefficient de temps de la base de temps retardée. En position CAL, le coefficient de temps du commutateur est etalonnée.
UNCAL	Lampe témoin indiquant que la commande CAL n'est pas en position étalonnée.

– COUPLAGE DE DECLENCHEMENT	Bouton-poussoir à 4 voies.
DC	Pleine largeur de bande (continu compris)
LF	Couplage par un filtre passe-bas pour les fréquences jusqu'à 30 kHz (pour le déclenchement par un signal extérieur, le filtre passe-bas agit de 7 Hz à 30 kHz).
HF	Couplage par un filtre passe-haut pour fréquences supérieures à 30 kHz.
TTL	Déclenchement automatique aux niveaux TTL. Commande de réglage continuellement de niveau hors de service.

Si aucun bouton n'est enfoncé, on obtient le même effet que si le bouton DC était enfoncé.

– TRIG SELECTOR	Bouton-poussoir à quatre voies.
A enfoncé	Déclenchement interne sur voie A après temps de retard.
B enfoncé	Déclenchement interne sur voie B après temps de retard.
EXT enfoncé	Déclenchement sur signal externe après temps de retard par l'intermédiaire de la douille d'entrée de déclenchement externe adjacente.
MAIN TB enfoncé	La base de temps retardée démarre immédiatement après le temps de retard.

Si aucun bouton n'est enfoncé, le circuit fonctionne comme si le bouton A était enfoncé.

– EXT TRIG INPUT	Entrée pour déclenchement externe.

2.2.5. Compteur d'événements et retard

Fig. 2.5. Compteur d'événements et retard

– Affichage LED	EV allumé	Nombre d'événements (impulsions) à compter est affiché.
	DIV allumé	Nombre de divisions de l'affichage du TRC en mode DELAY et en mode ΔT est affiché, lorsque le vernier MAIN TB n'est pas en position CAL.
	S ou Hz allumé	Un temps est affiché si le bouton 1/T n'est pas enfoncé, tandis que la fréquence est affichée si ce bouton est enfoncé.
Bouton de réglage (SET)		Contrôle le nombre d'événements à compter en mode de comptage d'événements. Contrôle le temps DELAY et le temps d'intervalle ΔT dans les mode respectifs.
– Sélecteur d'événements (EVENTS) et de mode de retard (DELAY)		
EVENTS BEFORE DTB		Le compteur d'événements est utilisé au retard de la base de temps retardée.
EVENTS BEFORE MTB		Le compteur d'événements est utilisé au retard de la base de temps principale.
DELAY		La base de temps retardée démarre un certain temps après le démarrage de la base de temps principale. Ce temps est réglable à l'aide du bouton SET.
ΔT (Intervalle)		Double base de temps retardée. Le temps d'intervalle entre les deux balayages de temps retardé est réglable à l'aide du bouton SET et affiché sur l'affichage LED. Utilisé pour les mesures de temps entre deux points d'un signal complexe.
1/T		Si le temps DELAY ou ΔT est égal à une periode du signal la fréquence du signal est affiché sur l'affichage LED.

2.3. QUELQUES INFORMATIONS SUR LES PRINCIPES DE FONCTIONS DU PM 3263

2.3.1. Entrées A et B

L'oscilloscope est pourvu de deux voies identiques, toutes deux pouvant être utilisées soit pour des mesures YT avec un ou deux générateurs de base de temps, soit pour des mesures XY avec la voie horizontale externe.

Mesures YT

Pour afficher un signal d'une des voies verticales, il suffit d'actionner le bouton-poussoir A ou B des commandes de mode d'affichage vertical.
Lorsque le bouton-poussoir ALT ou CHOP est enfoncé, deux signaux différents peuvent être affichés simultanément. Le coefficient de déviation Y et la polarité peuvent être sélectionnés pour chaque voie séparément. Lorsque le bouton ALT est actionné, l'affichage est commuté d'une voie à l'autre au retour du signal de base de temps.
Quoique le mode ALT puisse être utilisé à toutes les vitesses de balayage du générateur de base de temps, le mode CHOP donne une meilleure qualité d'affichage pour longs temps de balayage. En effet pendant les temps de balayage longs, l'affichage alterné des deux signaux d'entrée est visible.

En mode CHOP, l'affichage est permuté d'une voie à l'autre à une fréquence fixe.
Si le bouton-poussoir ADD du commutateur de mode d'affichage est actionné, les signaux des deux voies verticales sont additionnés. En fonction des positions des commutateurs de polarité, la somme ou la différence des signaux d'entrée est affichée. Le mode ADD permet également des mesures différentielles.
Lorsque les commutateurs de polarité des deux voies sont mis en positions opposées, les parties mode commun des signaux aux prises A et B subissent une très légère amplification par rapport aux parties de mode différentiel.

Mesures XY

Si les boutons-poussoirs EXT X DEFL des commandes de déviation horizontale et A des commandes TRIG OR X DEFL sont actionnés, les générateurs de base de temps sont déconnectés. Un signal appliqué à la voie verticale A est alors utilisé pour la déviation horizontale. Le commutateur AC/0/DC et l'atténuateur par échelons de la voie A restent en service. La commande continue des coefficients de déviation est possible avec la commande X DEFL/HOLD OFF et le décadrage de la trace horizontale avec la commande X POSITION.

La voie verticale B peut également être utilisée pour la déviation X. Pour ce faire, le bouton B des commandes TRIG OR X DEFL doit être enfoncé.
Pour la déviation X, il est également possible d'utiliser une tension interne à la fréquence secteur ou un signal extérieur appliqué à la douille EXT située sur la partie inférieure droite du panneau, après avoir enfoncé le bouton-poussoir correspondant des commandes TRIG OR X DEFL. Dans ces modes, la largeur de trace peut être commandée avec le potentiomètre X DEFL/HOLD OFF.
Lorsque ce potentiomètre est en position CAL, le coefficient de déviation pour un signal extérieur est de 50 mV/DIV.
Le signal externe peut être couplé en continu ou en alternatif (fréquence inférieure 7 Hz) en enfonçant le bouton DC ou LF des commandes de déclenchement de la base de temps.

Commutateur AC/0/DC

Les signaux observés sont appliqués aux prises d'entrées A et/ou B et le commutateur AC/0/DC est réglé soit sur AC soit sur DC en fonction de la composition du signal. Du fait que l'amplificateur vertical est couplé directement, tout la bande passante de l'appareil est disponible et le composantes continues sont affichées comme des décalages de trace en position DC du commutateur AC/0/DC. Ceci peut ne pas convenir lorsque de petits signaux superposés à des tensions continues doivent être représentés. Chaque atténuation du signal résulte en une atténuation de la petite composante alternative.
Le remède à cet état est d'utiliser la position AC du commutateur d'entrée, lequel comprend un condensateur de liaison servant à supprimer les signaux continus et basse fréquence. Lorsque des signaux rectangulaires à basse fréquence sont représentés, on obtient une certaine pente de toit.

En position 0 le signal est interrompu et l'entrée de l'amplificateur est mise à la terre, sur cette position, le niveau 0 V est rapidement déterminé.

2.3.2. Base de temps

Les circuits de base de temps délivrent une tension en dents de scie en vue de la déviation horizontale linéaire. La vitesse de déviation horizontale est calibrée de telle sorte qu'on obtient un affichage exact et en rapport au temps.

Pour obtenir un affichage stable, la tension en dents de scie de la base de temps doit être démarrée chaque fois au même point de l'onde (encore appelé "déclenchement").

Base de temps principale

La base de temps principale comporte trois modes:

AUTO : Le générateur de base de temps est en fonctionnement libre en l'absence de signaux de déclenchement.
Dès qu'un signal de déclenchement est présent, un affichage stable est obtenu.

TRIG : Le générateur de base de temps ne fonctionne que lorsqu'un signal de déclenchement est présent.
En cas d'absence de signal de déclenchement, l'affichage reste sombre.

SINGLE : Le générateur de base de temps ne fonctionne qu'une seule fois à la réception d'une impulsion de déclenchement. Ce mode est souvent utilisé pour photographier des phénomènes uniques.
Aprés un balayage simple la base de temps est préparée en vue de la réception de l'impulsion de déclenchement suivante, et ce en enfonçant à nouveau le bouton SINGLE.

Blocage variable

Le temps de blocage est le temps qui s'écoule entre la fin d'un balayage de la base de temps et le moment auquel le circuit est prêt à déclencher à l'impulsion de déclenchement suivante.
En cas de signaux composés (par ex. signaux à double impulsion), le double déclenchement peut en résulter et conséquemment un affichage instable. Afin d'éviter ce déclenchement double, le temps de blocage peut être réglé à l'aide de la commande HOLD OFF.
En position CAL de ce même bouton, le temps de blocage est minimal.

Base de temps retardée

Le générateur de base de temps retardée est en principe identique au générateur de base de temps principale. Cependant, ce générateur fonctionne seulement pendant le balayage de la base de temps principale.
La base de temps retardée est généralement utilisée pour une inspection plus détaillée de signaux complexes.
Si le bouton DEL'D TB est enfoncé, seule la base de temps retardée est affichée.
Lorsque le bouton MAIN TB de la source de déclenchement BTR est enfoncé, le balayage de BTR démarre à un certain moment pendant le balayage de la base de temps principale.
Etant donné que le rapport entre temps de balayage BTP et BTR peut être élévé, quelque jitter peut apparaître au seul affichage de la base de temps retardée. Ce jitter peut être supprimée en déclenchant la base de temps retardée par A, B ou EXT. Le temps lu sur l'affichage LED n'est dès lors plus précis, alors UNCAL 1 est indiqué.
L'oscilloscope PM 3263 propose une base de temps retardée double (mode ΔT). Deux balayages de base de temps retardée sont possibles sur un balayage de base de temps principale. Le balayage de la base de temps retardée est généralement sur un court temps afin d'obtenir une fonction de marquage.
Le temps de retard et le temps ΔT peut être lu sur l'affichage LED.
Autre nouveauté: l'oscilloscope PM 3263 déclenche après le comptage d'événements, et ce soit en base de temps principale, soit en base de temps retardée. Le nombre d'événements (impulsions) peut être réglé entre 0 et 99999.

Le compteur d'événements ne compte que les impulsions de déclenchement présentes dans le circuit de déclenchement de BTR.
Le compteur d'événements commence à compter à la réception d'une impulsion de déclenchement de la BTP.

Agrandisseur de base de temps MAGN

L'agrandisseur de base de temps est actionné par un commutateur push-pull à deux positions incorporé dans la commande POSITION horizontale. Lorsque ce commutateur est tiré en position x10, les vitesses de balayage du générateur de base de temps principale sont augmentées d'un facteur 10. Donc, en x1 (TB MAGN enfoncé) la portion du signal affichée sur une largeur égal à une division au centre de l'écran occupe la largeur totale de l'écran en positon X10. Chaque portion de la trace peut être rapportée sur l'écran à l'aide de la commande de POSITION horizontale.
En position x10, le coefficient de temps est déterminé en divisant par 10 la valeur TIME/DIV.

Avec TB MAGN enclenché, l'affichage LED n'est pas modifié (x1).

Utilisation de la base de temps alternée (ALT TB)

Le PM 3263 est équipé d'une commutation d'affichage. De ce fait, l'utilisateur obtient un affichage simultané du signal sur les deux échelles de temps, l'un provenant de la base de temps principale et l'autre de la base de temps retardée.
Une portion de l'affichage de la base de temps principale peut être examinée en détail en allongeant l'intervalle de temps en question à l'aide de la base de temps retardée. Cette expansion est obtenue en sélectionnant un balayage plus rapide de la commande TIME/DIV de la base de temps retardée.
La portion de signal détaillée par la base de temps retardée demeure portion intensifiée de l'affichage de base de temps principale. Ceci ne facilite pas seulement le détail lors du réglage, mais il sert aussi d'indication visuelle. L'observateur peut comparer directement le détail avec le signal total (peut-être très complexe) sans devoir commuter entre MAIN TB et DEL'D TB.
Le décadrage vertical entre les deux affichages de base de temps est continûment variable à l'aide de la commande TRACE SEP.

2.3.3. Déclenchement

Lorsqu'un signal doit être représenté, le(s) générateur(s) de base de temps doit (doivent) toujours être démarré(s) à un point fixe du signal, et ce afin d'obtenir une trace stationnaire. Le générateur de base de temps est donc démarré par des impulsions de déclenchement étroites produites dans l'unité de déclenchement et commandé par un signal qui peut provenir: d'un des signaux appliqués aux entrées verticales, d'une tension interne à la fréquence du secteur, ou d'une source extérieure.

Les impulsions de déclenchement sont produites dans l'unité de déclenchement en comparant le signal d'entrée avec une tension continue réglable (LEVEL).
Le niveau de déclenchement est rapporté au taux de déviation verticale en cas de déclenchement interne (A ou B) et à la tension d'entrée en cas de déclenchement externe (EXT).

Couplage de déclenchement

Quatre méthodes de couplage de déclenchement sont possibles avec le commutateur DC/LF/HF/TTL. En positions HF et LF, la caractéristique de transfert est limitée.
En position DC, le signal de déclenchement reste inchangé.
En position LF, un filtre passe-bande de 0 Hz (7 Hz pour déclenchement externe) à 30 kHz est incorporé.
Cette position peut être utilisée pour réduire l'interférence du bruit.
En position HF, un filtre passe-haut de 30 kHz est incorporé.
Cette position peut être utilisée pour réduire l'interférence du ronflement par exemple.
En position TTL on obtient un déclenchement automatique sur niveaux TTL.
L'espace de déclenchement est alors de valeur fixe (la commande LEVEL ne fonctionne pas).

Source de déclenchement

Le signal de déclenchement est obtenu à partir de la voie A ou B (source interne) ou d'une source externe par la douille EXT. En cas de déclenchement interne le signal de déclenchement n'est pas affecté par la commande continue AMPL.

Base de temps principale

La base de temps principale peut être également déclenché par un circuit atténuateur 1:10 permettant aisni des tensions supérieures de déclenchement externe.
Le déclenchement composite est choisi en enfonçant les deux boutons A et B.
Dans ce mode, le signal de déclenchement est prise de la voie A ou B en fonction de la voie affichée.
A noter que le déclenchement composite n'est pas applicable dans le mode CHOP, parce que la tension CHOP est alors traitée comme tension de déclenchement.

Le déclenchement secteur (= déclenchement par un signal dérivé de la tension secteur) est sélectionné en enfonçant les boutons EXT et EXT ÷ 10.

2.3.4. Micro-processeur

Ses tâches principales consistent à:

- Vérifier la position des commandes de panneau avant.
- Charger l'affichage LED
- Charger le compteur d'événements
- Charger le convertisseur digital-analogique afin d'obtenir la tension de comparateur pour BTR.
- Calculer la valeur 1/T.

2.4. REGLAGES PRELIMINAIRES

2.4.1. Etalonnage GAIN

- Actionner le bouton-poussoir A des commandes de mode d'affichage.
- Actionner le bouton-poussoir AUTO des commandes de mode de déclenchement.
- Actionner le bouton-poussoir MAIN TB des commandes de déviation horizontale.
- Centrer la trace avec la commande POSITION appropriée.
- Régler les commandes INTENS et FOCUS afin d'obtenir une trace nette et fine.
- Régler le commutateur AC-0-DC sur DC.
- Régler le commutateur AMPL sur .5 V et la commande continue sur CAL (étalonnée).
- Connecter la prise d'étalonnage CAL à la prise d'entrée A.
- Vérifier si la hauteur de trace est exactement de 6 divisions.
  Au besoin, rajuster la commande GAIN sur le panneau avant, juste sous le commutateur AMPL.

Si une sonde atténuatrice 1:10 utilisée, régler le commutateur d'amplitude sur 50 mV/DIV.
Vérifier la réponse rectangulaire de la sonde.
Répéter cette opération pour la voie B.

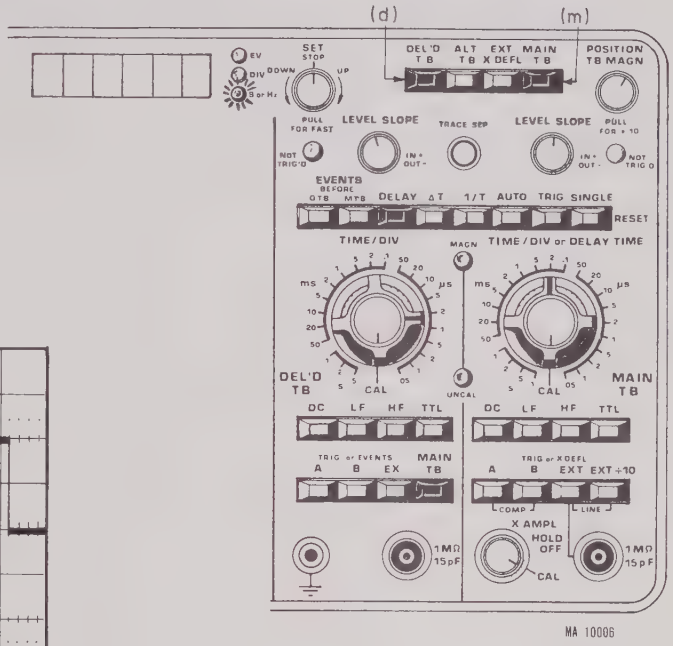
2.4.2. Rotation de trace

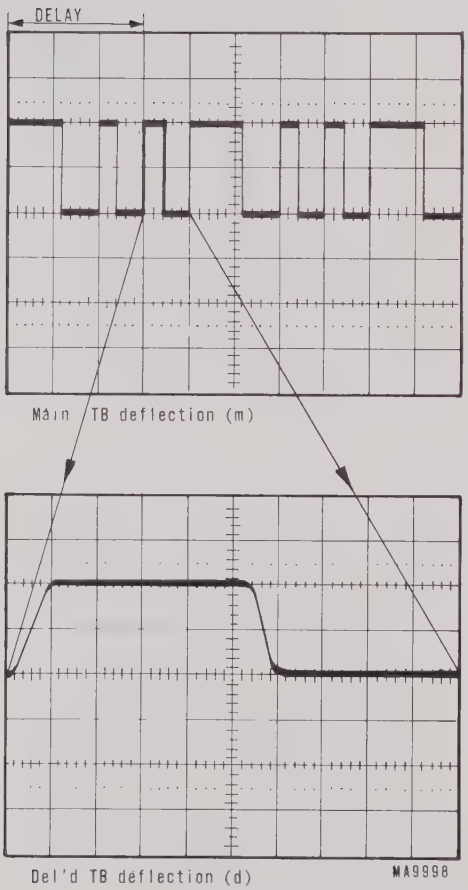
- Enfoncer le bouton-poussoir A des commandes de mode d'affichage.
- Enfoncer le bouton-poussoir MAIN TB des commandes de déviation X.
- Centrer la ligne de base de temps à l'aide des commandes POSITION.
- Vérifier si la ligne de base de temps est parfaitement parallèle aux lignes de graticule horizontales; au besoin, rajuster la commande TRACE ROT sur le panneau avant.

2.5. INFORMATION DETAILLEES SUR LES MODES "RETARD" ET "COMPTEUR D'EVENEMENTS"

2.5.1. Mode "DELAY" (retard)

Dans ce mode les bases de temps principale et retardée fonctionnent toutes deux. Le balayage de la BTR est intensifié pendant le balayage de BTP.





Le temps de retard après lequel la base de temps retardée démarre est lu sur l'affichage LED. L'affichage indique une maintisse et un exposant de dix.

L'exposant peut être sombre (0), –3 ou –6, ce qui signifie respectivement secondes, millisecondes et microsecondes.

Le temps de retard est commandé à l'aide du bouton SET.

Dans les versions précédentes cette commande se faisait à l'aide d'un bouton calibré 10-tours indiquant un facteur entre 0 et 100 % par lequel il fallait multiplier le balayage BTP pour obtenir le temps de retard.

Le nouveau système permet de lire directement le temps de retard sur l'affichage.

Lorsque la déviation DEL'D TB (d) est sélectionnée, le balayage de BTR représenté sur l'affichage TRC tout entier. De cette manière le point de démarrage de la BTR peut être exactement réglé afin de lire avec précision optimale le temps de retard lu sur l'affichage LED. A noter que la valeur maximale lue sur l'affichage est égale au temps de balayage total de BTP.

Comme décrit la base de temps retardée est démarrée en un certain point*) du balayage de la base de temps principale, quelque jitter peut apparaître. Pour obtenir un affichage TRC sans jitter, la base de temps retardée peut être déclenchée par sélection A, B ou EXT; cependant, l'affichage LED indique UNCAL 1.

LED DIV

Lorsque le vernier MAIN TB n'est pas en position CAL, l'affichage LED ne peut indiquer le temps DELAY; cependant, le retard est indiqué en nombre de divisions sur l'affichage.
Dans ce cas, le témoin "DIV" est allumé et "S or Hz" éteint.

TB MAGN

Si TB MAGN est actionné; l'affichage LED n'est pas modifié et reste donc en affichage x1.

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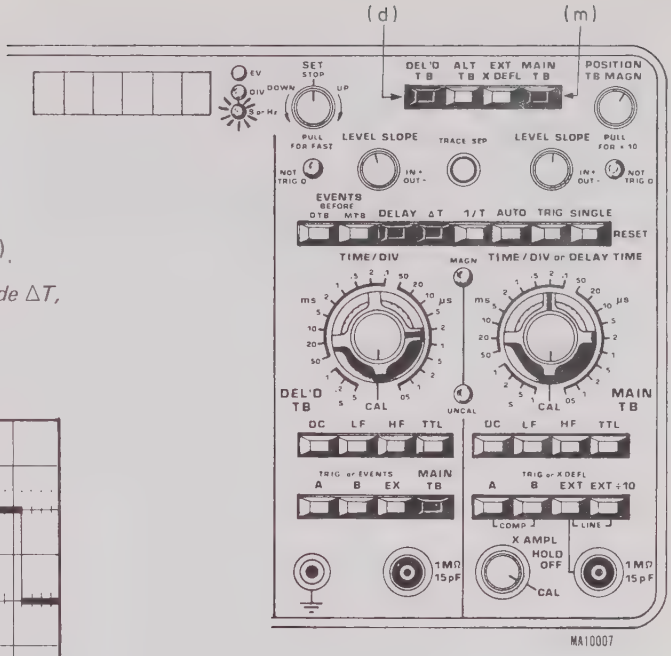
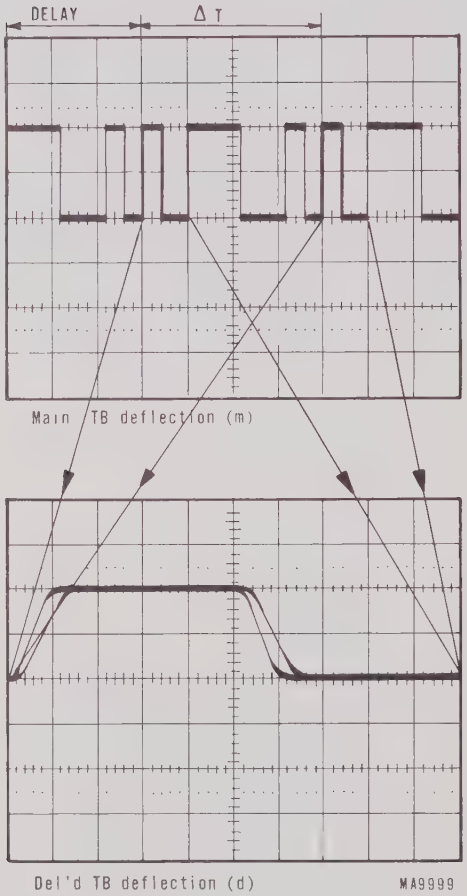
*) *En fait, la tension en dents de scie de la BTP est comparée à une tension continue dérivée de l'affichage LED.*

2.5.2. Mode DELAY et ΔT

Ce mode est une extension du mode DELAY. Lorsque le bouton ΔT est enfoncé, on obtient l'affichage TRC des deux balayages de base de temps retardée pendant le balayage de la base de temps principale*).

Remarque: A la sélection initiale du mode ΔT, les deux marqueurs de BTR coïncident.





ΔT est le temps qui s'écoule entre les points de démarrage des différentes balayages de base de temps retardée sur l'affichage TRC.

Le mode ΔT convient aux mesures de temps sur des signaux complexes. Les deux balayages de base de temps retardée sont utilisés comme marqueurs.

Le temps de retard et ΔT peuvent tous deux être commandés à l'aide du bouton SET.
En cas de déviation DEL'D TB (d) les deux balayages retardés sont représentés sur l'affichage TRC tout entier. Le bouton SET permet de faire coïncider ces balayages, et ce afin d'obtenir ΔT exact sur l'affichage LED.
A noter que pour commander le temps DELAY seul le bouton DELAY doit être enfoncé.
ΔT peut être actionné si le bouton ΔT a été enfoncé.
La valeur maximale du temps DELAY et du temps ΔT est égale au temps de balayage total de BTP.

Lors de la commande du temps en mode ΔT, la somme des temps DELAY et ΔT peuvent excéder le temps de balayage de BTP.
Cependant, le marqueur ΔT ne disparaît pas de l'affichage TRC, mais s'arrête à la fin du balayage de BTP.
Le temps ΔT reste stocké dans une mémoire interne de sorte que, si le temps DELAY décroît, le marqueur ΔT commence à dévier à un certain moment.

LED DIV

Lorsque le vernier MAIN TB n'est pas en position CAL, l'affichage LED ne peut indiquer le temps ΔT; cependant, le temps ΔT est indiqué en nombre de divisions sur l'affichage.
Dans ce cas, le témoin "DIV" est allumé et "S or Hz" éteint.

TB MAGN

Si TB MAGN est actionné, l'affichage LED n'est pas modifié et reste donc en affichage x1.

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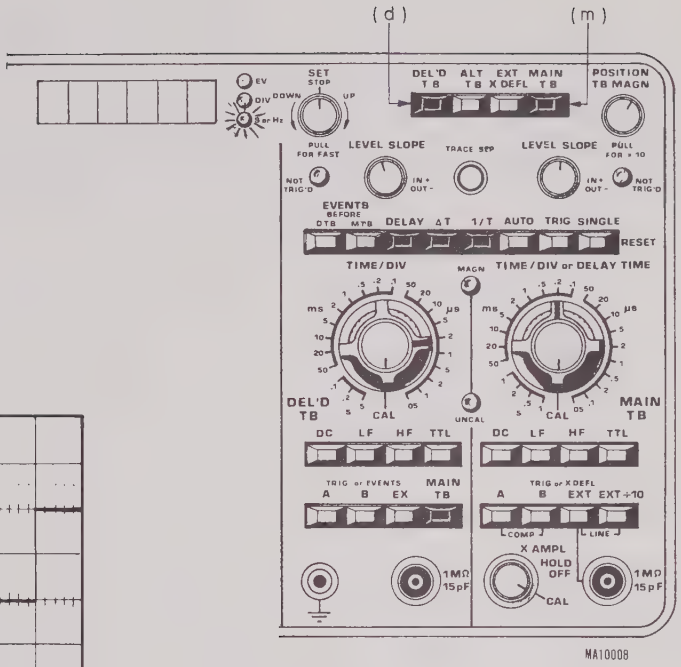
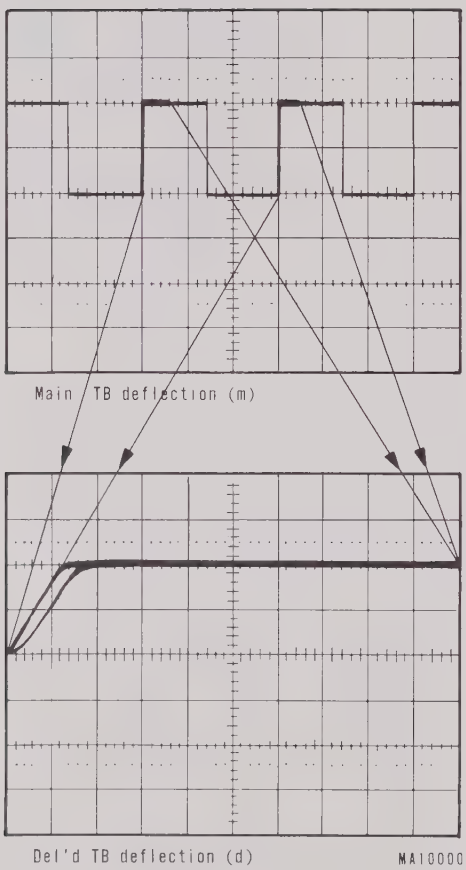
*) *En fait le balayage de base de temps retardée DELAY est écrit sur un balayage de base de temps principale et le balayage BTR DELAY et ΔT sur le balayage BTP suivant, et ainsi de suite.*

2.5.3. Mode 1/T

Ce mode est une extension du mode ΔT, et convient aux mesures de fréquence.



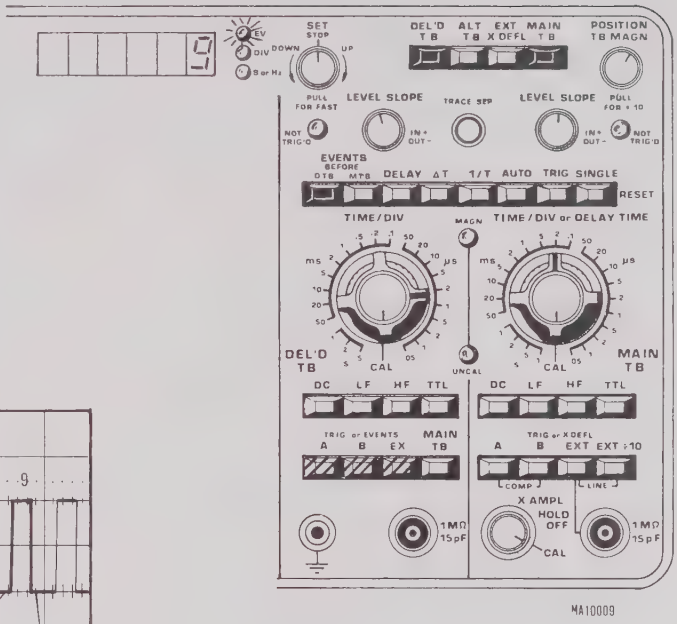


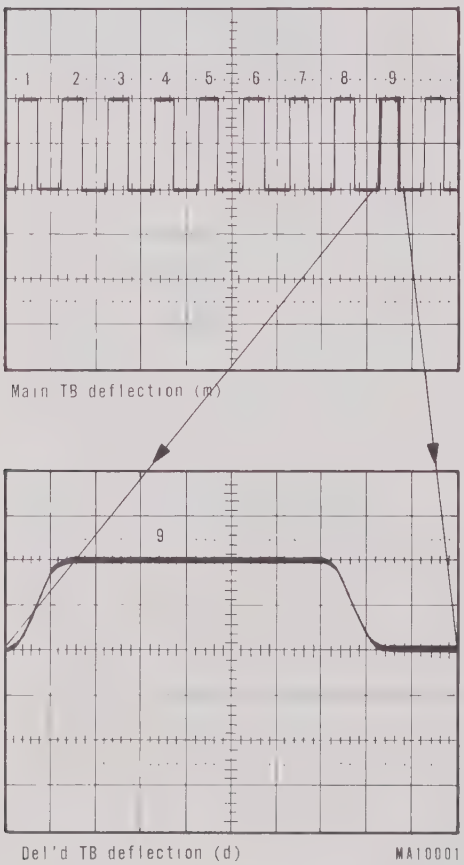
Si les deux marqueurs sont réglés sur le même point de deux cycles successifs d'un signal, la fréquence de ce signal peut être directement lue sur l'affichage LED, en enfonçant le bouton 1/T.

Pour obtenir un réglage précis des marqueurs, sélectionner la déviation horizontale DEL'D TB et vérifier si les deux marqueurs coïncident.

2.5.4. EVENTS BEFORE DTB (événements avant BTR)

Dans ce mode, la base de temps retardée est déclenché après comptage d'un nombre pré-sélectionné d'événements (impulsions). La base de temps retardée doit être déclenché à partir de A, B ou EXT.
Le nombre d'événements à compter est lu sur l'affichage LED et peut être commandé à l'aide du bouton SET.
Le nombre maxi d'événements à compter est de 99999.

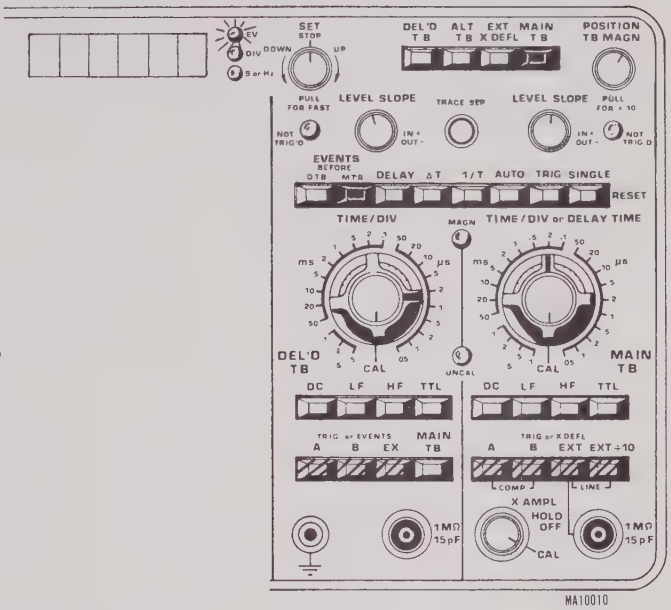




A noter que, si le bouton MAIN TB du sélecteur de déclenchement BTR est enfoncé, le message "erreur" est lu sur l'affichage LED (parce que dans ce cas il n'y a pas des signeaux trigger).
Le compteur d'événement commence à compter au point de départ du balayage BTP.
Si le témoin NOT TRIG'D (BTR) reste allumée, il se peut qu'un nombre supérieur d'événements au nombre disponible pendant un balayage BTP soit affiché, ou le réglage Trigger n'est pas bient ajusté.

2.5.5. EVENTS BEFORE MTB (événements avant BTP)

Dans ce mode, la base de temps principale est déclenchée après comptage d'un nombre présélectionné d'événements (impulsions) présents dans le circuit de déclenchement BTR (A, B ou EXT).
Le nombre d'événements à compter est lu sur l'affichage LED et peut être commandé à l'aide du bouton SET.
Le nombre maxi d'événements à compter est de 99999.
Le compteur d'événements commence à compter à la réception d'une impulsion de déclenchement BTP; de plus, le circuit BTP doit être déclenché par A, B ou EXT.



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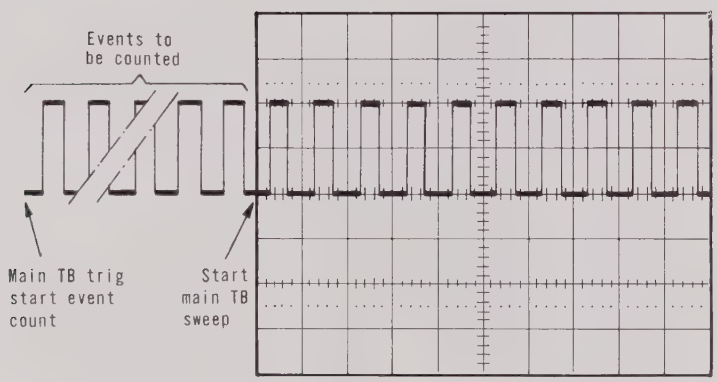

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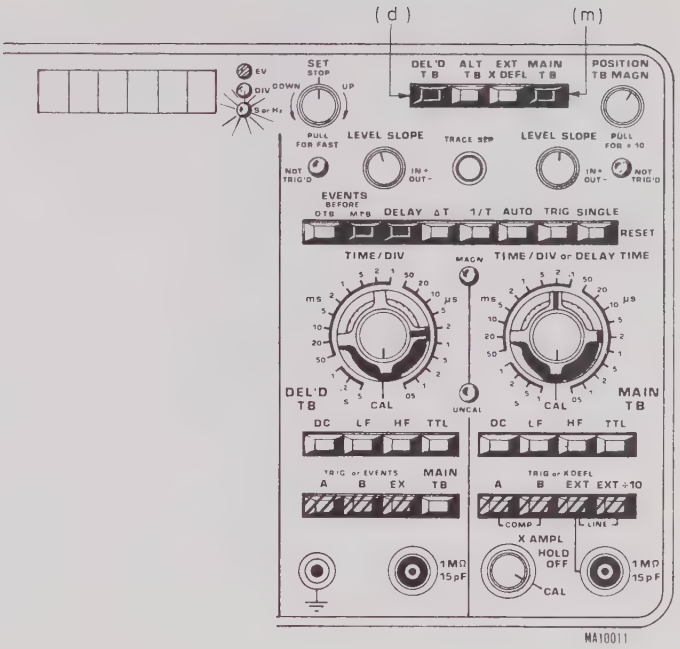
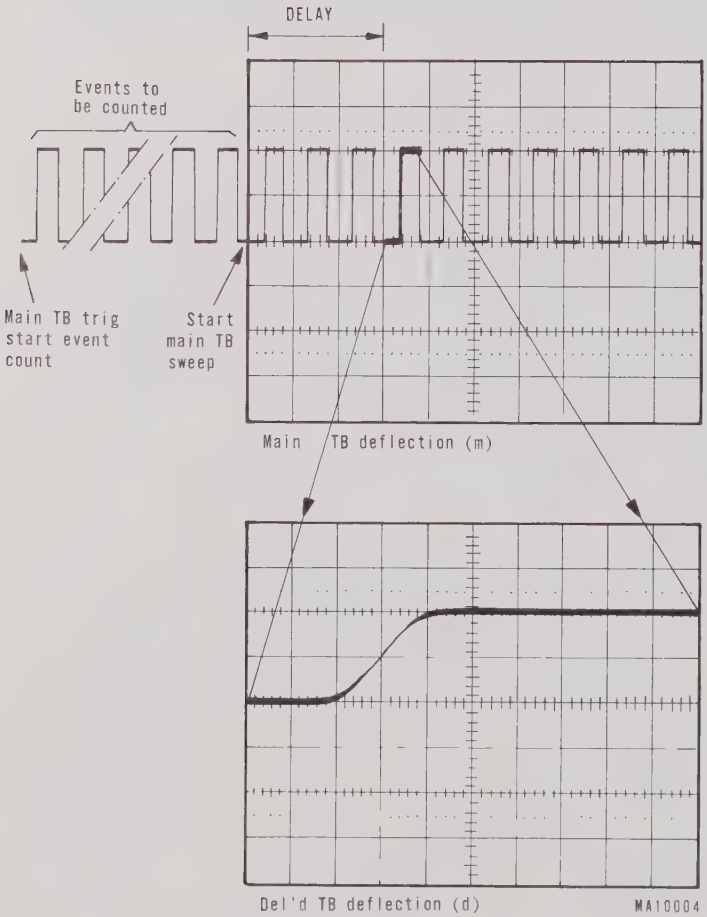
Pour une compréhension plus aisée, les événements à compter sont réprésentés à gauche sur l'affichage TRC.

Le mode EVENTS BEFORE MTB convient en combinaison avec les modes DELAY et ΔT.

2.5.6. EVENTS BEFORE MTB et DELAY (événements avant BTP et retard)

Il s'agit d'une extension du mode précédent.
La BTP déclenche après comptage d'un nombre présélectionné d'événements (impulsions) présents dans le circuit de déclenchement BTR (A, B ou EXT).
Enfoncer d'abord le bouton EVENTS BEFORE MTB et sélectionner le nombre d'événements à compter.

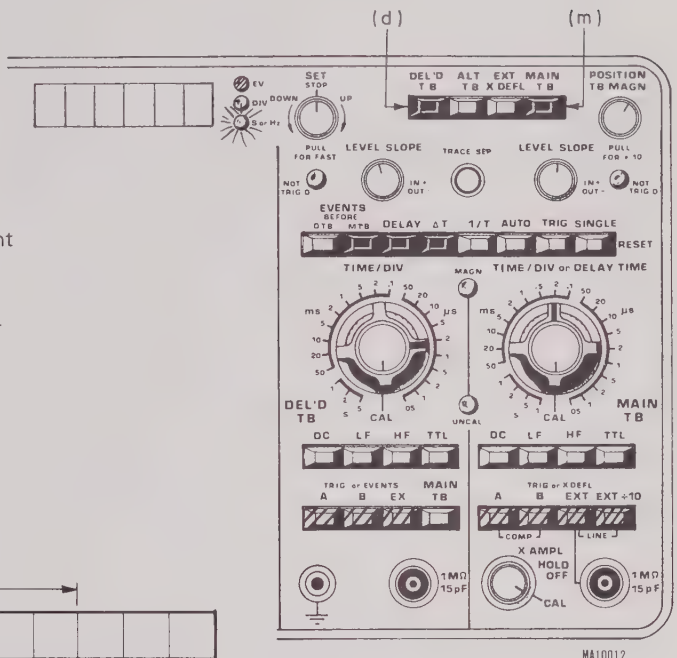


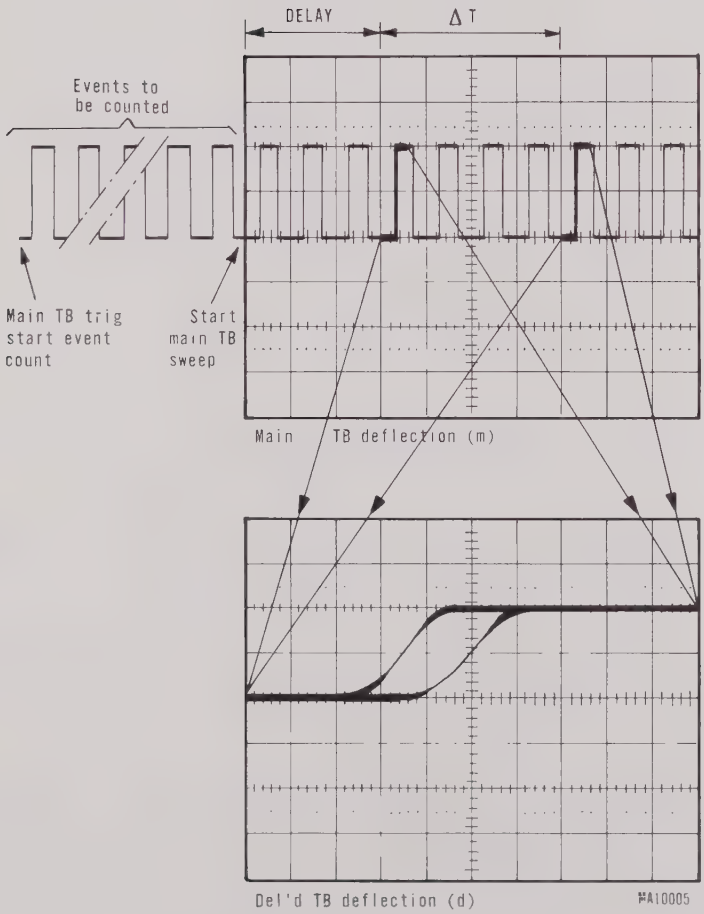


Enfoncer alors DELAY et sélectionner le temps de retard.

2.5.7. **Events before MTB et DELAY et ΔT** (événements avec BTP et retard et ΔT)

Il s'agit d'une extension du mode EVENTS BEFORE MTB. Les deux balayages BTR peuvent servir de marqueurs; ΔT est l'intervalle de temps entre les marqueurs.
La base de temps principale déclenche après comptage d'un nombre présélectionné d'événements présents dans le circuit de déclenchement BTR (A, B ou EXT).
Enfoncer d'abord le bouton EVENTS BEFORE MTB et sélectionner le nombre d'événements à compter.

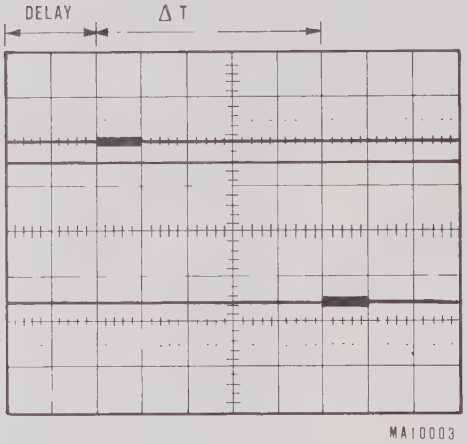




Ensuite, enfoncer DELAY et sélectionner le temps de retard (position du premier marqueur). Enfoncer également ΔT et sélectionner le temps d'intervalle (position du second marqueur). Pour le réglage précis du marqueur, sélectionner la déviation horizontale DEL'D TB et vérifier si les deux marqueurs coïncident.
Le mode 1/T peut être sélectionné lorsque les deux marqueurs sont situés en un même point des deux cycles successifs.

2.5.8. Delay et ΔT combinée à l'affichage alterné vertical

Si ce mode est sélectionné, la trace A indique seulement le premier balayage de la base de temps retardée et la trace B seulement le second.



Il s'agit là d'un mode utile à la mesure du temps entre deux différentes parties de deux signaux. Les deux signaux doivent être en rapport de temps (par ex. synchronisés par la même impulsion d'horloge).

Connecter un signal à l'entrée de voie A et l'autre à l'entrée de voie B.
La source de déclenchement de la base de temps principale peut être A, B ou EXT.
Sélectionner les deux parties du signal en réglant les temps DELAY et DELAY et ΔT.
Le temps entre les points de départ des deux sections de trace intensifiées est lu sur l'affichage LED.
Pour réglage précis, sélectionner la déviation horizontale DEL'D TB.

2.5.9. Affichage LED avec commande SET

Cet affichage comporte 6 digits. Il est allumé lorsque:

1. EVENTS BEFORE MTB est sélectionné

ou

2. DTB TIME/DIV n'est plus en position OFF

et

EVENTS BEFORE DTB
ou DELAY
ou ΔT
} est sélectionné

Indépendamment des conditions précédentes, l'affichage est allumé:

- pendant le test de mise en service, au moment au l'oscilloscope est mis en service
- en mode auto-test (voir section "Service" de la présente notice).

L'affichage LED indique:

- Un nombre d'événements (impulsions) en mode EVENTS BEFORE DTB ou MTB; le témoin EV est allumé. Le bouton SET permet de sélectionner tout nombre entre 1 et 99999.
- Une durée de temps en mode DELAY ou ΔT. Le temps est indiqué comme mantisse avec exposant de dix. Le temps maximale indiqué sur l'affichage LED est égal au temps de balayage de la base de temps principale.
- Une fréquence en mode 1/T. Indiqué comme mantisse avec exposant de dix.

Autres possibilités d'affichage:

– *TB OFF*

Indique que, pour déviation horizontale, EXT X DEFL a été sélectionné.

– *ERROR*

Indique que, en mode EVENTS, la source de déclenchement MAIN TB en fonction DEL'D TB a été sélectionné. Enfoncer A, B ou EXT du déclenchement BTR.

– *UNCAL*

L'affichage peut indiquer le mot UNCAL ainsi que le chiffre 1, 2 ou 3.
L'affichage UNCAL sert à faciliter la tâche de l'opérateur, lui indiquant qu'un mesurage calibré n'est pas possible dans ce cas.

UNCAL 1	Signifie que, en mode DELAY ou ΔT, la source A, B ou EXT a été choisie pour le déclenchement BTR. Enfoncer le bouton MAIN TB en fonction DEL'D TB.
UNCAL 2	Signifie que, en mode 1/T; la distance entre les marqueurs est inférieure à 0,1 DIV; la valeur affichée n'est dès lors plus exacte. Choisir alors un balayage BTP plus court ou augmenter le temps à l'aide du bouton SET.
UNCAL 3	Indique que, en mode 1/T, le vernier de balayage BTP n'est pas en position CAL.

– *Témoin EV*

Est allumé lorsque l'affichage indique un nombre d'événements à compter.

– *Témoin DIV*

Est allumé lorsque, en mode DELAY ou ΔT, le bouton de balayage MAIN TB n'est pas en position CAL. Dès lors, l'affichage LED n'indique plus en temps, mais un nombre de divisions TRC.
Le témoin S or Hz est lors éteint.

– *Témoin S or Hz*

Est allumé en mode DELAY, ΔT ou 1/T.

– *SET*

Ce bouton permet de commander le(s) temps de retard en mode DELAY TIME ou ΔT, et le nombre d'événements à compter en modes EVENTS BEFORE DTB ou BEFORE MTB.
Toute manipulation de ce bouton influence directement l'information lue sur l'affichage LED.

En position centrale (STOP) de ce bouton, l'information sur LED reste inchangée. Cette valeur croît ou décroît en tournant le bouton respectivement vers la droite et vers la gauche. Au plus l'écart en fonction de la position centrale, au plus élevé est le changement sur LED. Ce taux augmente d'un facteur 100 en enfonçant le bouton SET.

Service manual

3. SERVICE DATA

3.1. DESCRIPTION OF THE BLOCK DIAGRAM (Refer to Fig. 3.1.)

3.1.1. General information

The PM 3263 oscilloscope comprises the following parts:

- a dual-channel vertical system
- a main time-base
- a dual-delayed time-base
- an event trigger-mode stage
- a display-mode logic stage
- an X amplifier
- a Z-stage
- a .c.r.t. circuit
- a micro-processor circuit
- a stabilized power supply.

3.1.2. Dual-channel vertical system

Both vertical channels (YA and YB) contain identical circuits. An input to one of the channels is applied, via a coupling switch AC/0/DC to the input attenuator. In the AC position of the coupling switch there is a capacitor in the signal path. In the DC position the coupling is direct.
If the coupling switch is set to the 0 position, the connection between the input socket (X3-Y_A, X4-Y_B) and the attenuator input is interrupted, the latter being earthed.

The input attenuator, which is controlled by the AMPL/DIV switch, enables the adjustment of the vertical-deflection sensitivity in calibrated steps.

The attenuator is followed by a low-drift impedance converter with drift compensation which gives the input circuit a high input impedance.

The impedance converter also contains a voltage divider, which works in conjunction with the input attenuator.

The signal that leaves the impedance converter is applied to a balance amplifier (D201-Y_A, D301-Y_B) where it is transformed into a push-pull signal. The balanced amplifier has two outputs. From one of these outputs the signals are applied to a trigger selector stage and from the other one to an amplifier stage (D202-Y_A, D302-Y_B).

This stage comprises the switch NORMAL/INVERT by means of which the phase of each signal can be inverted, and the controls for vertical positioning.

The following stage is a channel selector which either blocks or passes the signal as dicated by the vertical display-mode logic and switches.
In the A, B, ADD and TRIG VIEW modes the channel selector is set by means of voltage levels (via the display-mode logic stage) and in the ALT and CHOP mode controlled by pulses (also via the display-mode logic stage).
In the ALT mode those pulses are supplied by the sweep-gating multivibrator of the main time-base generator during the flyback of the sweep, so that alternately the complete signals of channel A, channel B and the 3rd channel TRIG VIEW are displayed.
In the CHOP mode the drive pulses with a fixed frequency of approximately 1 MHz are derived from the clock-signal of the micro-processor.
Those pulses cause the electronic switches in the display-mode logic stage to be successively opened and closed, so that successively part of the signal of channel A, channel B and the 3rd channel TRIG VIEW are displayed.

After the channel selector, the following circuits are common to the vertical channels:

A delay line driver stage, a delay line that delayes the vertical signals to such an extent that the steep leading edges of fast signals are still displayed and a final Y-output stage, which feeds the signals to the vertical-deflection plates.

3.1.3. Time bases

Main time-base

The M.T.B. trigger and X-deflection amplifier (V803, V804, V806) receives its signal, via pre-amplifiers, from one of the vertical channels or both (COMPOSITE), from the attenuator/impedance converter for external trigger or X-deflection signals, or from the power supply (LINE). One of those signals can be selected by operating one of the controls incorporated in this stage (i.e. EXT, EXT/10, LINE, A, B, COMP.).
From this stage the signal is fed to either the X-deflection amplifier for horizontal deflection, or the sweep-gating logic for starting the time-base generator. The output used to feed the sweep-gating logic is also fed to the event counter to start the count when the event counter triggering is used for the main time-base.
The M.T.B. trigger amplifier (including D802) is a differential one, containing the controls for trigger-level adjustment, slope selection, and coupling (i.e. DC/LF/HF and TTL) selection.
The slope selector allows the polarity of the trigger signal to be inverted, enabling triggering on the positive as well as the negative slope of the input signals.

The sweep-gating logic starts and stops the time-base generator, which delivers the sawtooth signal required for normal time-base operation.
The generator comprises the charging capacitors and current source-resistors selected by the TIME/DIV switch in order to set the time coefficients in calibrated steps. Continuous control of the time coefficients is obtained by varying the charging current of the time-determining capacitors by means of the TIME/DIV continuous potentiometer; in this case, the UNCAL lamp is on.

The amplified output signal of the time-base generator is fed to the X-deflection selector, the comparator (which is a part of the delayed time-base unit) and (via a feedback loop) to the hold-off circuit. The hold-off circuit resets the sweep-gating flip-flop (D901) and blocks its input during the flyback of the sawtooth signal. The hold-off circuit also incorporates the single-sweep circuit.

The three modes of operation of the main time-base are determined by the three-position switch AUTO/TRIGG, SINGLE.
In the AUTO mode, the automatic free-run circuit is operative when triggering pulses are absent. Thus a trace, though not necessarily a stationary one, is always displayed even though the trigger controls may not be correctly adjusted. In this way, correct adjustment of the oscilloscope trace is greatly facilitated. However, when trigger pulses are present the circuit reverts to the normal triggered mode. If trigger pulses disappear, the time-base free-runs after a lapse of approx. 100 ms. In the TRIGG mode, a display is present only when suitable trigger pulses are available.
In the SINGLE mode, events that occur only once can be observed and photographed if necessary. It is often desirable to ensure that only one sweep is generated, even though other trigger pulses might follow the phenomenon of interest. In this mode, after the trigger pulse has initiated the main time-base to produce one sweep, the circuit is unaffected by further trigger pulses until it is manually reset for the next event by operating the reset pushbutton.

Dual-delayed time-base

The delayed trigger-circuit and delayed time-base generator are in principle, similar to the main trigger-circuit and the main time-base generator. The delayed time-base works in the single or dual operation mode. It is started by the main time-base generator, which also serves as hold-off circuit for the delayed time-base.

For time, events or frequency measurements in complex signals the dual-delay facility is used. In the PM 3263, the usual delay time multiplier control potentiometer is superceded by the SET potentiometer which controls oscillator (VCO). The number of pulses selected is stored in the memory of the microprocessor (μP) and transferred to the LED display. By means of digital counters in the dual DAC, two d.c. voltages are produced by pulse-width modulation that correspond to the delay and ΔT times. These two d.c. voltages are alternately switched to the comparator D1303 for display on alternate main time-base sweeps. The ΔT is the elapsed time between the starting points of the two delayed time-bases.

The 1/T mode is an extension of the ΔT mode and enables if ΔT = 1 cycle, a frequency indication of the displayed signal on the LED display. (The S or Hz lamp will be lit in the delay, ΔT or 1/T modes.
With the MTB TIME/DIV knob out of the CAL position the delay and/or ΔT times are indicated in divisions (the lamp DIV is on).
When pushbutton MAIN TB of the horizontal deflection mode controls has been depressed, the part of the trace coinciding with the delayed sweep is intensified, except in the OFF position of the delayed TIME/DIV switch.

Event trigger-mode stage

Triggering after pre-selecting a number of events is possible for both the main time-base and the delayed time-base. By means of the SET control the number of required pulses (events) before triggering can be set between 0 and 99999 and can be stored in the event counter.
The event counter counts only the trigger pulses that are present in the delayed time-base trigger circuit, although counting is started by the MTB trigger pulse.
Selecting the number of events before triggering is internally achieved by putting the 9's complement into the counter. The event counter then counts up to 99998 whereupon it frees the trigger so that the next pulse triggers the time-base.

The EVENTS BEFORE DTB/MTB control pushbuttons determine which of the time-bases will be triggered after the number of events pre-selected and indicated in the LED display (the EV lamp will be lit in this condition).

3.1.4. X-Deflection selector

The X-deflection selector couples the external X-deflection signal, the output signal of the main time-base generator or the output signal of the delayed time-base generator via the X-final amplifier, to the horizontal-deflection plates. The X-final amplifier comprises the horizontal trace positioning and 10x magnification controls.

The ALT and CHOP mode stages supply blanking pulses to the Z-amplifier.
ALT pulses unblank the trace during the sweep of the main time-base and provide an extra bright-up pulse if the oscilloscope operates with a portion of the trace intensified. CHOP pulses suppress the trace during the switching from channel Y_A to channel Y_B and/or the 3rd channel TRIG VIEW.

3.1.5. Z-Amplifier and c.r.t. circuit

The Z-amplifier receives two input signals. One originates in the time-base generator and is, via the X-deflection selector and ALT mode circuit, applied to the Z-amplifier to unblank the trace during the sweep.
The other one is supplied by the chop-mode circuit to blank the trace during switching from channel to channel in the chopped mode. The INTENS potentiometer determines the amount of input current fed to the Z-amplifier.
At the output of this amplifier, the signal is split into two parts: an l.f. + d.c. part and an h.f. part. The h.f. part is fed direct to the Wehnelt cylinder of the c.r.t. The l.f. + d.c. part is modulated on to an oscillator signal and afterwards detected in a peak-detector. Both signal parts are combined again on the Wehnelt cylinder.

The focus voltage for the c.r.t. is derived from a grid driver stage. The output voltage of this stage is rectified and applied to the focussing anode.
The focussing voltage is controlled by the FOCUS potentiometer which is electronically coupled with the INTENS potentiometer. In this way, defocussing due to operation of the INTENS potentiometer is largely obviated.
The high voltage for the post-acceleration anode of the c.r.t. is supplied by a secondary high tension winding of the converter transformer whose voltage is rectified and multiplied by a factor of 9.
Furthermore, the c.r.t. circuit comprises preset potentiometers for trace rotation, astigmatism, distortion and orthogonality.

3.1.6. Stabilized power supply

The mains voltage is full-wave rectified and fed to a regulated sine converter. The output voltage of the sine converter is kept constant by regulating the duty cycle of the applied voltage. This output voltage is applied to the primary of a transformer, the secondary voltages of this transformer are full-wave rectified, smoothed and applied to the various circuits.
The voltages required for the microprocessor, the event counter (partly ECL), the LED display and so on are made by an additional unit which is supplied from the power supply unit.
The MAINS triggering signal is taken direct from the mains and is fed, via an opto-isolator, to the trigger circuit at a safe level.
The calibrator is a square-wave generator, which supplies an accurate voltage and current for calibration purposes.

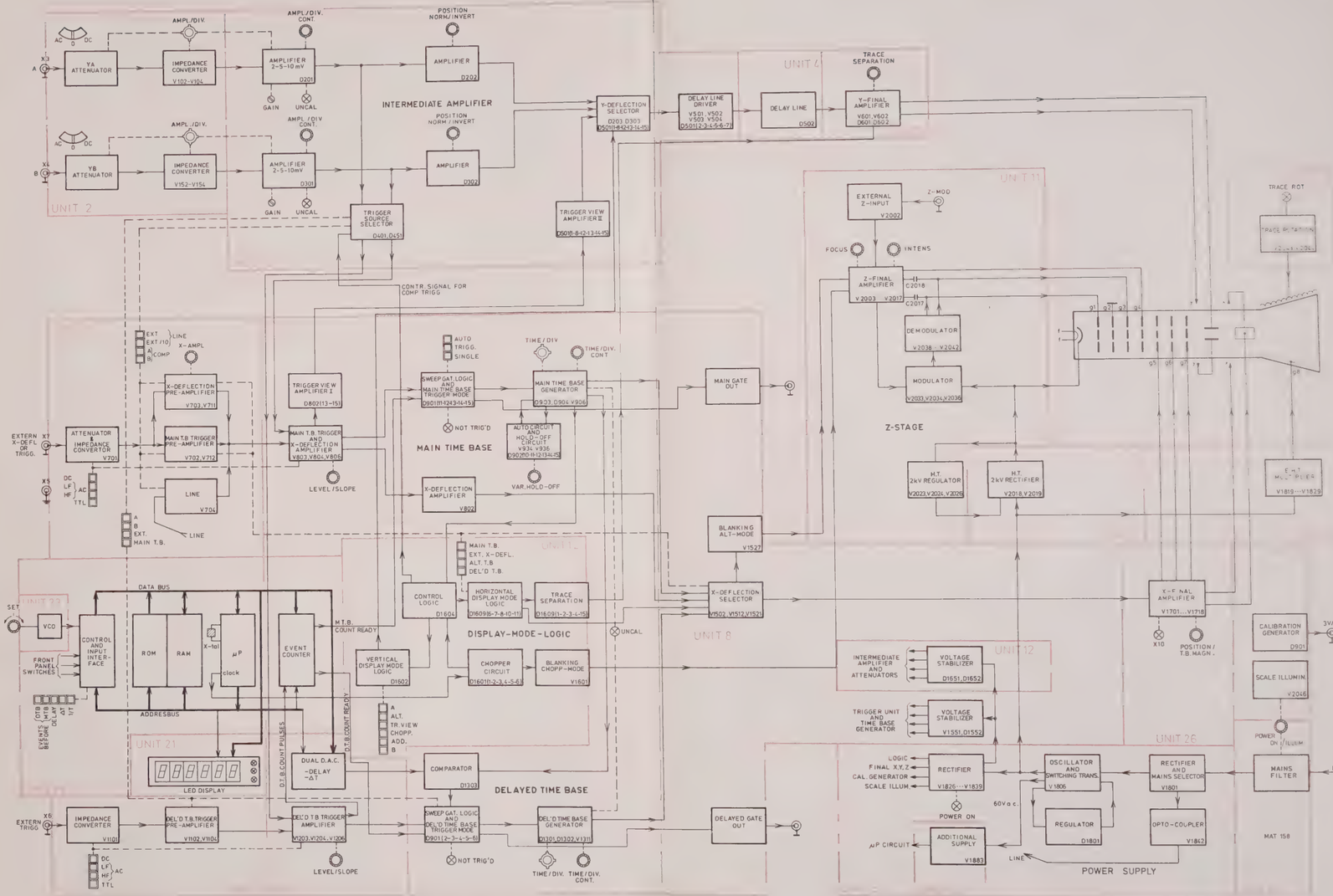


Fig. 3.1. Blockdiagram

3.2. CIRCUIT DESCRIPTION

3.2.1. Vertical deflection system

The oscilloscope contains three vertical channels, channels A and B and the TRIGger VIEW channel.
The vertical channels A and B for the signals to be displayed are identical, each comprising an input coupling switch, an input step attenuator, an impedance converter and a preamplifier with trigger pick-off.
A channel switch, controlled by the display mode pushbuttons, switches either channel A or channel B or the TRIGger VIEW channel to the final Y amplifier via the delay line driver and the delay line. The final Y amplifier feeds the Y deflection plates of the cathode-ray tube.
The individual stages of the vertical deflection system are now described in some detail.
As the channel paths for channel A and channel B are basically identical, only the channel A signal path is described.

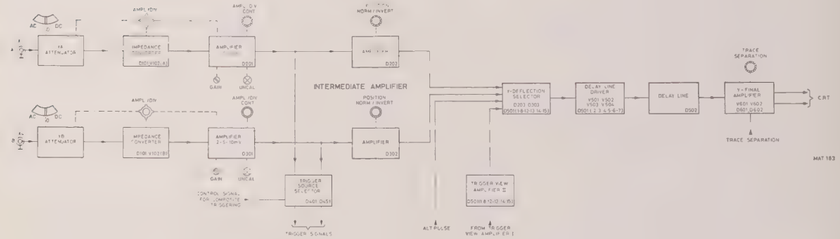


Fig. 3.2. Vertical deflection system

3.2.1.1. Input coupling

Input coupling switch S17 (AC-0-DC) forms a part of the input attenuator unit (Unit 2).
Input signals connected to the A input socket X3 can be a.c. coupled, d.c. coupled or internally disconnected.
In the AC position of S17, there is a capacitor (C102) in the signal path. This capacitor prevents the DC component of the input signal from being applied to the amplifier and reduces so the lower frequency limit to 10 Hz.
In position DC of switch S17, the input signal is coupled directly to the step attenuator and at the same time, blocking capacitor C102 is discharged via R101, to prevent damage of the circuit under test by a possible high charge.
Selection of the 0 position of S17 isolates the channel A input signal and earths the channel input for reference purposes; e.g. for calibration or centering the trace.

3.2.1.2. Input attenuator and impedance converter

The input stage comprises two identical attenuator circuits which are combined in one unit (unit 2).
For convenience, only the channel A attenuator is described.

The input attenuator consists of a triple high-ohmic voltage divider and an impedance converter in conjunction with a drift-correction circuit. The impedance converter provides an output at zero level, which can be adjusted by potentiometer R129, followed by a low-ohmic attenuator with attenuation factors of 1, 2 and 5.

The overall attenuation of the input stage is determined by the combination of the selected sections of two voltage dividers. The various combinations are selected by the eleven positions of the front panel AMPL/DIV attenuator switch S9.

The high-ohmic voltage divider sections attenuate by a factor of X1, X10 and X100. The low-ohmic divider D102 following the impedance converter, V102, V103, V104 gives attenuations of X1, X2 and X5 at the output. With the overall combinations of attenuation, eleven Y deflection coefficients are realised from 2 mV/DIV to 5 V/DIV in a 1-2-5 sequence. Only for the most sensitive positions 2 mV/DIV and 5 mV/DIV of the AMPL/DIV switch S9, the gain of the intermediate amplifier is increased.

Constant input capacitance for the various attenuator positions is achieved by trimmers C101, C104 and C109. The high-ohmic voltage divider sections are made independent of the input frequency (i.e., the capacitive attenuation for a.c. signals is adjusted to the resistive attenuation for d.c. signals) by means of trimmers C107 and C112.

A diode clipper V101, in the gate circuit of FET-transistor V102 protects the input source follower of the impedance converter from excessive voltage swings.

The high frequency path of the input signal consists of capacitor C114 and FET-transistor V102 connected in a source-follower configuration. The low frequency path of the input signal consists of error amplifier D101, which samples the input and output signals of the impedance converter over a frequency range from d.c. to 1 kHz. The error amplifier generates a correction signal on pin 6 which is fed to the impedance converter to replace the missing low frequency components of the high frequency path.
The gain of the low frequency path is set by adjusting the resistor divider ratio from which the output is sampled. Preset R 132 (L.F. corr) is adjusted so that the ratio of the network R134/R132 is the same as the ratio of network R122/R123. The off-set voltage of the error amplifier is corrected by preset R124.

After low-ohmic attenuator switching, the output from the impedance converter provides a correct impedance match for the coaxial cable to the intermediate amplifier.

3.2.1.3. Intermediate amplifier

The intermediate amplifier comprises two main stages.
The first stage comprises the gain adjustments, vernier and continuous control, level shifting, and sensitivity for the 2 mV, 5 mV and 10 mV ranges.

The second stage comprises a series-shunt feedback amplifier circuit formed by D202 input transistors and transistors V502, V504 on the delay-line driver circuit. Interposed in this stage are the normal/invert, shift and electronic switch facilities.

Both stages have overall gains of approximately 3.

To improve temperature control and stability, the intermediate amplifier mainly comprises integrated circuits. The signal paths for channel A and channel B are identical in the input stages, consequently, only the channel A input circuit is described.

The Y signal from the channel A attenuator is applied to a coaxial input socket on the intermediate amplifier, via R204 to pin 3 of integrated circuit D201. The asymmetrical input is converted to a symmetrical output in a transistor balance amplifier.

Potentiometer R212 provides a continuous balance control to correct for line shift.
Four diode-connected transistors across the base circuits of the D201 cascode transistors provide control of attenuation by means of GAIN control R12 and CONT. control R8, which vary the dynamic resistance of the diodes. Control R12 gives 5 % loss of gain in the mid-position and 10 % loss of gain at minimum. Control R8 gives a 3 to 1 attenuation, which is sufficient to give the desired overlap between the input attenuator steps. When the currents through the diode bridge are equal, there is no gain and the transistors are cut off. When current flows in one diode and not in the other, the gain is maximum.

The cascode transistors V204 and V203 that follow integrated circuit D201 provide additional gain for the most sensitive ranges by the selection of load resistors. By switching this additional gain at intermediate amplifier level a reduction in noise is achieved.
The different loads of V203, V204 are selected by switching diodes under the control of the front-panel AMPL switch positions.
In the 10 mV-5 V positions the - 5.2 V supply from AMPL/DIV switch S9 contact 14 is applied to the junction of R241, stabistor V205 and diode V208. The stabistor V205 conducts and applies the negative potential via switching diode V206 to load resistors R228 and R236 of V204 and V203 respectively. Diode V208 also conducts and blocks V211, thus causing transistor V212 to switch off and disconnect the load resistors R231 and R234.

In the 5 mV position, the - 5.2 V supply from AMPL/DIV switch S9 contact 20 is applied to the junction of R242, and diodes V209, V210. Diode V210 conducts and applies the negative potential via switching diodes V207 to the load resistors R229 in series with R228, and R233 in series with R236 of V204 and V203 respectively. Diode V209 also conducts and blocks V211, thus causing transistor V212 to switch off and disconnect the remaining load resistors. To compensate for the reduction of bandwidth in the 5 mV position because of the higher value of the load resistor, an additional capacitor, C202, is switched into the emitter circuit via R209 and diode V201.

In the 2 mV position, transistor V212 conducts because of the 0 V applied to its base via R246 and V211. The resulting negative potential on its collector is applied to the total load resistors R231, R229, R228 and R234, R233, R236 of V204 and V203 respectively. In this position, switching diodes V206 and V207 are blocked. The 2 mV position is an extra facility, the bandwidth being degraded to 35 MHz.

To compensate for any shift of the trace that may occur when switching between the 5 mV and 10 mV positions, preset R222 is provided. It permits the emitter current of V203 to be adjusted, as required.

Emitter potentials for V203 and V204 are routed via feed resistors R224 and R227 respectively. The RC networks R226, C213 and R230, C212 provide damping. Series RC networks R221, C214 and R214, C206 on points 1 and 8 of the cascode circuit of D201 prevent any tendency for parasitic oscillation.
The second stage of the intermediate amplifier is a voltage-to-current amplifier that incorporates the trigger pick-off point, the NORMAL/INVERT switching facility, and the channel selection switching. The stage basically comprises two integrated circuits D202 and D203.
Emitter points 4 and 5 (D202) of the input transistors provide the trigger pick-off points that are routed to resistors R403 and R414 on the trigger circuit. A number of RC networks across the common emitter circuit provide for bandwidth compensation over the frequency range. Preset components are R253, R254 R255 and C221.

The NORMAL/INVERT function is performed by a diode-gate switching circuit under the control of the PULL TO INVERT switch S4. In the NORMAL position, i.e. S4 is open, transistor V216 conducts because of the negative base potential applied via diode V217 and resistor R263. Point 11 of D202 is therefore at 0 V and this is applied to the bases of two transistors, which conduct and pass the signal through D202 without inversion (points 1-14, 8-12). The negative potential via R262 is passed to point 9 of D202 on the appropriate side of the diode gate network. This negative potential is applied to block the bases of the other pair of transistors in the signal path.

In the INVERT position, i.e. S4 is closed, V216 is cut off because of the 0 V potential applied via V218. Point 11 of D202 now becomes negative via R261 and this switchess off the two transistors that were previously conducting. The signal path is now inverted through the integrated circuit (points 1-13, 8-15) by the 0 V signal applied via S4, R264 to point 9 of D202.

Any trace shift due to inversion can be corrected by preset R259.
The output signals are fed to pins 1 and 8 of integrated circuit block D203, the emitters of the electronic switching transistors. Channel selection is by means of a diode-gate network, controlled from the logic circuit.

Front-panel POSITION control R3 applies a variable potential to the base of one of the input transistors to provide a means of shifting the trace. Transistor V219 provides a constant-current source, unaffected by the shift control.

3.2.1.4. Trigger pick-off and trigger source selection

The symmetrical trigger inputs from the A channel intermediate amplifier (D202) are fed via resistors R403 and R414 to points 3 and 6 of D401.
The symmetrical trigger inputs from the B channel intermediate amplifier (D302) are fed via resistors R453 and R464 to points 3 and 6 of D451.
Diode switches are again employed for channel switching for triggering on channel A, channel B or for composite triggering.
The outputs are asymmetrical and are taken via coaxial sockets to the trigger amplifier of the Main and Delayed time-bases.
The operation of the two integrated circuits D401 and D451 is identical. Therefore, only the channel A circuit D401 is described.

Transistor V401 provides a constant current source for the trigger pick-off stage for channel A. The collector output (point 7) is resistor-coupled to the common emitters of the switching transistors to provide a high gain output on point 13 (MTB trigger output) and point 15 (DTB trigger output) when the appropriate triggering is selected. Switching is achieved by front-panel selection. When channel A (DTB) is selected, the +11,4 V from point 2 of S21-A (which blocks V403 in the channel A OFF position) is removed and V403 conducts the channel A trigger signal (D401/15) to the delayed time-base trigger amplifier. When channel A (MTB) is selected, the +11,4 V from point 1 of S22-A is removed and V404 conducts (V407 off) to pass the channel A trigger signal on D401, point 13) to the main time-base trigger amplifier.

In the composite triggering mode, which is only functional when also ALT mode is selected, point 4 of S22-A is open circuited, consequently, transistors V408 and V458 and also transistors V457 and V407 are now controlled by a signal coming from the vertical logic circuit via R1622 and V462. This signal brings transistors V458 and V408 alternately into conduction to enable triggering on the channel being displayed.
Transistor V459 inverts the logic input signal to allow alternate switching of the two channels.
Diodes V454 and V404 are alternately conducting and the A and B trigger signals are alternately routed to the MTB trigger amplifier.
Presets R426 and R476 enable the switching points of the diodes V404 and V454 to be set.
Presets R472 and R422 compensate for any current differences between the A and B triggering signals to enable the same current to be delivered to the trigger amplifiers.

3.2.1.5. Vertical display mode logic

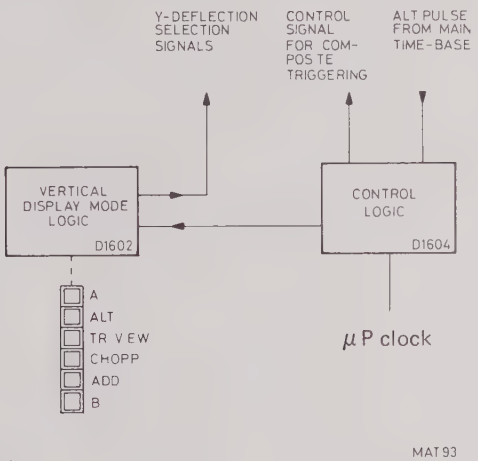


Fig. 3.3. Vertical display mode logic

This logic consists of digital circuits employing dual-in-line TTL integrated circuits. Vertical mode selection is made by selector switch S1.
The outputs that can be selected by the vertical display mode selector switch S1 are:
– channel A only
– channel B only
– TRIG VIEW signal only
– channels A and B added, chopped or alternated
– TRIG VIEW signal and channels A and B, chopped or alternated.

Positive logic is used in the digital circuits, the levels being as follows:
logic "1" = +5 V (high)
logic "0" = 0 V (low)

The different functions of the logic circuits are now described according to the vertical display mode selector switch S1.

A — selects channel A only. Via switch S1 the S input (point 7) of flip-flop D1604 is set to +5 V and the R input (point 8) to 0 V. The "high" level at output 10 is fed via two NOR circuits and R1628 and R1626 to R289 in the A channel preamplifier to open the A channel signal path.
At the same time the control signals for the B and the TRIG VIEW channel are 0 V.

B — selects channel A only. Via switch S1 the S input (point 7) of flip-flop D1604 is set to 0 V and the R input (point 8) to +5 V. The high level at output 11 is fed via two NOR circuits and R1627 and R1624 to R389 in the B channel preamplifier to open the B channel signal path.
At the same time the control signals for the A and the TRIG VIEW channel are 0 V.

ADD — adds channels A and B. Inputs 2 and 5 of NOR circuits D1603 are connected to +5 V via switch S1, consequently both outputs 1 and 4 are low. They are fed via the NOR circuit and the resistors to R289 and R389 in the A and B channel preamplifiers to open both signal paths simultaneously. The TRIG VIEW control signal is 0 V then.

TRIG VIEW — selects the trigger signal only. Via switch S1 a +5 V is applied to points 4 and 5 of NAND D1607 (4-5-6). Output point 6 is fed via NOR D1602 (1-2-3) and resistors R1629 and R1623 to R547 in the trigger view amplifier to open the trigger view signal path.
The channel A and B control signals are 0 V then.

CHOP — selects channels A and B chopped. In this position the clock signal from the microprocessor , is switched into the circuit by a + 5 V applied to input 4. The frequency of oscillation is 2 MHz. The output signal is fed via two NANDS to the clock input of flip-flop D 1604. The only flip-flop of interest now is the first one. It divides the incoming frequency by two and switches at a frequence of 1MHz. The resulting high switching levels on the outputs 10 and 11 of the flip-flop provide the chopping signals for the A and B channels. The control signal for the TRIG VIEW channel is blocked in this situation. During switching over in the CHOP mode, the c.r.t. is blanked by pulses supplied via transistor V 1601 to R 2002 of the blanking stage.

ALT — selects channels A and B alternately for display. The circuit acts as in the CHOP mode, only the chopper generator is blocked and the circuit is driven now by the much slower switching signal applied to input 2 of NAND D1608 (1-2-3).
This switching signal is derived from the main time-base generator (V903) or the alternate time-base logic. These pulses switch the circuit at the end of each sweep and the channels A and B are alternately displayed.
In ALT TB mode the circuit is switched at the end of every two sweeps.
The control signal for the TRIG VIEW channel is 0 V.
This switching signal swhich is derived from the main time-base generator (V 903) or the alternate time-base logic is taken off from point 8 of D 2617. These pulses switch the circuit at the end of each sweep and the channels A and B are alternately displayed. In ALT TB mode the circuit is switched at the end of every two sweeps. The control signal for the TRIG VIEW channel is 0 V..

ALT TRIG VIEW — selects channels A and B and TRIG VIEW alternately. So three signals can be made visible on the screen, but only one at a time is written.
For the generation of the control signals see Fig. 3.4. Clock pulses are here the alternate pulses.

TRIG VIEW CHOP — selects channels A and B and TRIG VIEW chopped. Three signals can be made visible on the screen, but now in chopped mode.
For the generation of the control signals see Fig. 3.4. Clock pulses are here the chopper generator output pulses.

Composite triggering

The output signal of point 10 of flip-flop D1604 is applied via R1622 to diode V462 in the trigger source selector.

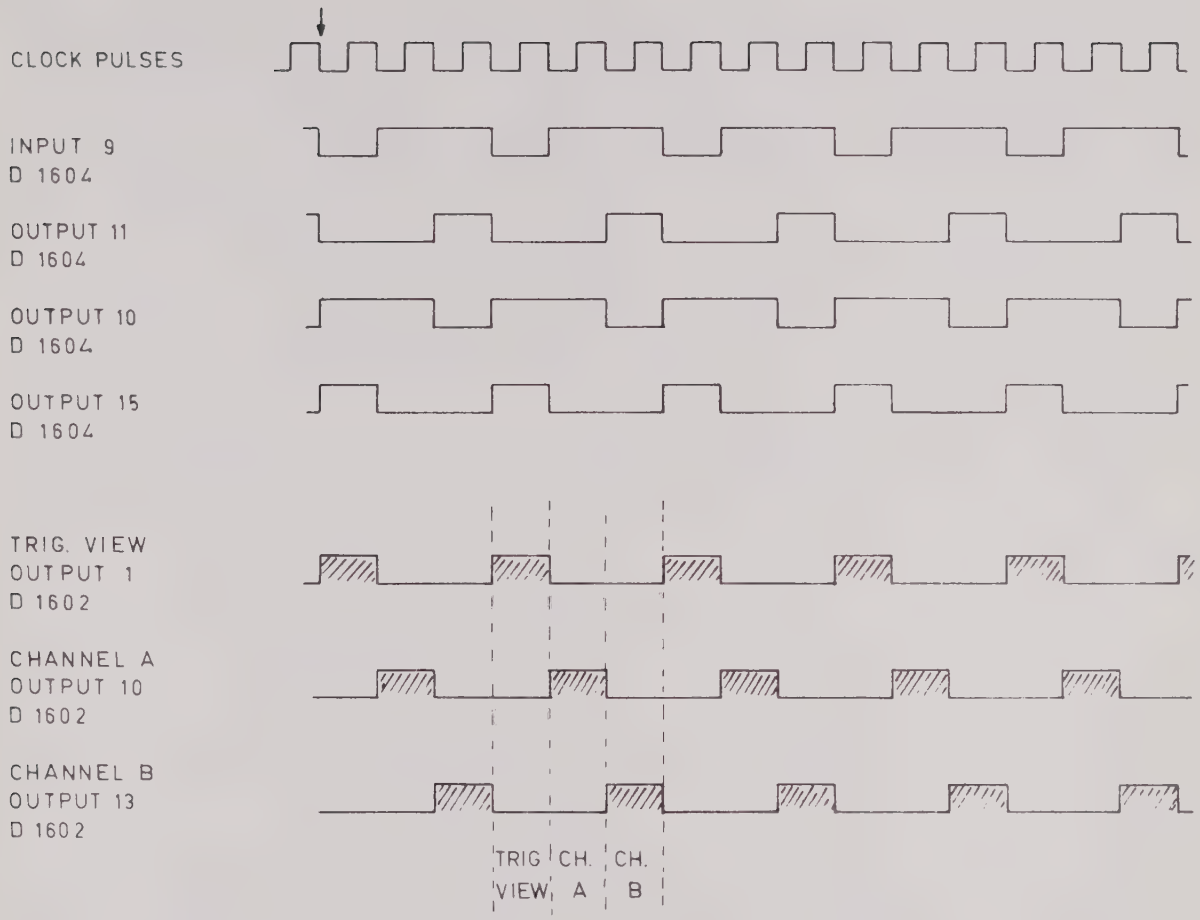


Fig. 3.4. Generation of control pulses.

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3.2.1.6. Delay-line driver

The signal collector outputs from D203 (points 12 and 14) are coupled to the bases of the output transistors V502, V504 of the shunt-series feedback amplifier and each normally draws 10 mA from the current source of V501, V503.
When the channel is switched off by the diode-gate network, the signal transistors are blocked and the alternative transistors are switched on so that they now draw 20 mA current from the +11,4 V rail via resistors R502, R501, R508, R507.
Similarly, the collector outputs from D303 of the channel B intermediate amplifier are also coupled to the bases of V502, V504.
In the ADD position, with both the A and B channels switched in, 20 mA is fed to V224 and V322 and, similarly, 20 mA to V222, V324. Since the alternative transistors in D203 and D303 are now switched off, only 10 mA is drawn via the R501 and R507.
The table shows the current distribution in the stage for the various operating modes.

MODE	CURRENT DISTRIBUTION		
A switched	10 mA through V224	20 mA through V509, V323	10 mA through V222
B switched	10 mA through V322	20 mA through V509, V223	10 mA through V324
ADD switched	20 mA through V224, V322	10 mA through V509	20 mA through V222, V324
TRIG VIEW	10 mA through V508	20 mA through V223, V323	10 mA through V511

By the use of alternative transistors in the various switching modes, the current demands of delay-line driver stage are constant irrespective of the switching.

The collector outputs of transistors V502 and V504 are direct-coupled to the bases of the output transistors of the delay-line stage (points 3 and 6 respectively of integrated circuit D501). Resistor R541 in the emitter circuit provides gain compensation for temperature changes in the stage. The collector outputs on points 2 and 7 of D501 feed the combined output resistor R552, the value of which, 120 ohms, matches the characteristic input impedance of the delay line.

A cable-type delay line is used with a characteristic output impedance of 75 ohms. From the delay line, the signals are routed to the vertical output amplifier stage, via input resistors R602 and R609, which terminate the delay line in 75 ohms. Transistors V601 and V602 in common-base configuration provide the first stage of the vertical output amplifier.

3.2.1.7. Final Y amplifier

The voltage signals present on R604 and R613 are applied to the bases of transistors (point 3 and point 6) of integrated circuit D601.
The emitters of these transistors (points 4 and 5) are fed from a constant-current source, V606, via transistors V607 and V603. The base of V607 is controlled via V608 from the TRACE SEP; potentiometer R6 on the time-base circuit.
This potentiometer varies the current on the side of the balanced amplifier to give trace separation in the ALTERNATE TB mode.
The networks R634, C613, R636, C614 and C616 provide delay-line correction at different frequencies.
High frequency compensation for this stage is achieved by V609, C617 and V611, C618 adjusted by preset R646. The NTC resistor temperature-controls the vari-cap capacitance and compensates for increase in temperature.
Integrated circuit D601 and thin-film circuit D602 form a shunt-series feedback circuit, followed by a cascode amplifier with voltage output developed across the load resistors inside D603.
The Y plates of the c.r.t. are fed via series chokes L601 and L602 damped by the parallel resistors R662 and R664.

Together with the capacitance of the c.r.t. plates, this forms a series resonant circuit to lift the gain at the high frequency end of the bandwidth. Preset R654 provides a measure of gain adjustment (20 % approx.) to allow for different c.r.t. sensitivities.
It controls the quiescent current of the diodes and thus the gain of the D601 amplifier stage.
Any unbalance in the c.r.t. deflection plates can be corrected for by the line centring preset R658, which provides a compensating current for one side of the balanced output stage.

3.2.2. Main time-base triggering

The trigger source switches for triggering the main time-base generator, can select any of the following input sources.:

- an internal signal from the vertical A channel
- an internal signal from the vertical B channel
- an internal composite signal of channel A and channel B
- a signal derived from the mains supply
- an external source.

All these sources can be used for both triggering and X Deflection purposes. Source selection is done by means of a trigger selector switch S22.

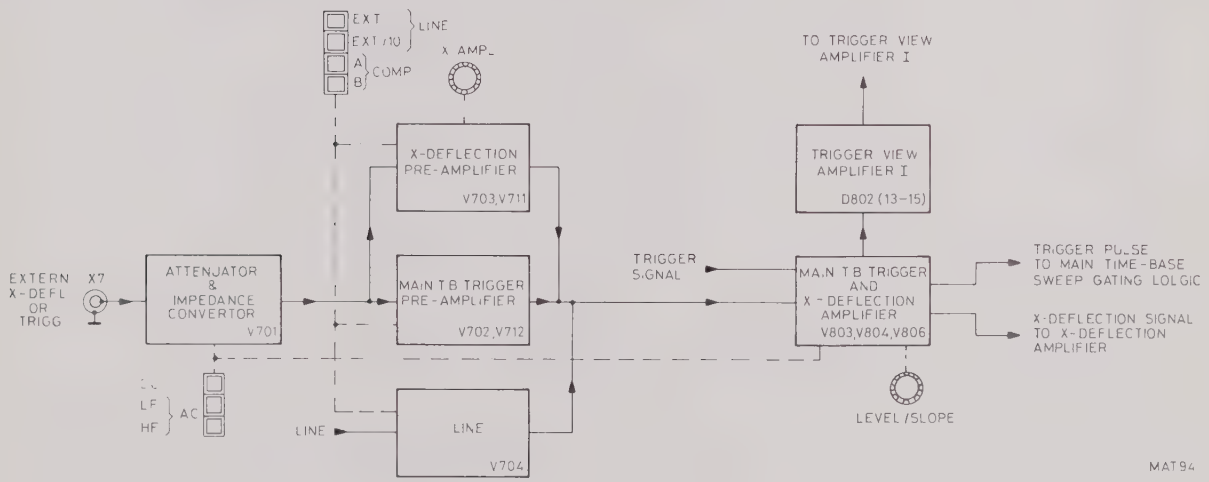

Fig. 3.5. Main time-base trigger circuit

3.2.2.1. Main time-base trigger source selector and preamplifier

The signal which is applied to the external trigger or X-deflection input X7 is attenuated via R702 and R703 by a factor of 10 in the EXT ÷ 10 mode.
When DC coupling is selected with switch S20, a DC path is formed via the resistors R707 and R708 to input 3 of D701. In the LF and HF mode the DC path is blocked. The l.f. component of the signal is fed via capacitor C704 to point 3 of D701 and the h.f. component is then fed via capacitor C703 to FET transistor V701. The output signal from V701 and D701 is then applied to the bases of the transistors V712 and V711.

In the modes A, B, COMP and LINE the junction of R714 and R718 is connected to ⏚ via switch S2, transistors V702 and V703 are conducting thus blocking the signal paths via the diodes V708 and V709.

In LINE mode R722 is not longer connected to ⏚ and transistor V704 is blocked. Diode V707 will conduct and the signal path for the LINE signal is opened.

When modes EXT or EXT ÷ 10 are selected there is no voltage applied via S22 to the junction of R714 and R718. In these modes there is only one of the transistors V702 and V703 conductive and the other one is then blocked.

If V702 is conductive, the signal path via diode V709 will be blocked. The signal path via diode V708 will be blocked when V703 is conductive.
If V702 or V703 conducts depends on the setting of switch S2.
There is no voltage applied via S2 to R716 and R717 in normal horizontal deflection by MTB and/or DTB signals. Transistor V702 is blocked, V706 and V703 conduct and the signal path via diode V709 is opened.
In EXT-X DEFL mode a +5 V signal is applied to R716 and R717 and V702 is conducting. At the same time V706 and V704 are blocked and the signal path via diode V708 is opened. The X-AMPL potentiometer R18 in the emitter circuit of V711 is now brought into the circuitry.

3.2.2.2. Main time-base trigger amplifier

The main time-base trigger amplifier consists of an input stage, coupling filters and a final amplifier. In this trigger amplifier, there is an output taken off for trigger view.

The signal current from the intermediate amplifier (channel A, channel B, or composite) is fed via the trigger source selector circuit to the emitter of V803. The output from the trigger source (EXT, EXT ÷ 10, or LINE i.e. mains frequency) is also fed to the emitter of V803.
This transistor, connected in common-base configuration, is coupled to the shunt feedback stage V804, V806.
The output of this stage is diode-coupled to the filters for the various coupling modes.
By means of these filters, the input frequency range of the trigger circuit can be set.
The desired filter is switched in by biasing the appropriate switching diodes in the forward direction via two resistors. For example the DC and TTL position, selected by switch S20, are switched in by the − 11,4 V which causes diodes V 809 and V 812 to conduct. The LF and HF modes are selected in a similar way. The filter section is coupled to an emitter-follower V 813, which compensates for the temperature drift of transistor V 804.

transistor V804.

On the trigger amplifier, the trigger view signal and the trigger signal progper are split up by means of two amplifier stages.
The two transistors V 816 and V 817 accept the trigger signal. The transistors V 814 and V 818 accept the trigger level voltage.

The level voltage can be varied continuously with front panel LEVEL potentiometer R7, but in TTL mode (selected with S20) the level depends on the setting of adjusting potentiometer R 860.

The trigger view gain can be varied by means of preset potentiometer R 842 in the emitter circuit of transistors V 814 and V 816.

The collectors of transistors V 814 and V 816 provide the trigger view output and the collector current of transistors V 817 and V 818 are fed to the shunt feedback stage V 821 and V 822 respectively, thus providing the trigger signal.

In the negative position of the +/− SLOPE switch S7, the trigger signal is taken from one of the collectors via transistors V 824 and V 827 and in the positive position via transistors V 823 and V 826.

+/− SLOPE switch S7 determines the polarity of the trigger signal. In the closed position a 0 V signal causes V 827 to conduct the negative trigger, and also switches off V 829. In the open position , V 829 is switched on and the positive trigger which is routed via V 826 and V 827 is blocked.

In this way, the appropriate trigger signal appears at the combined emitters of transistors V 826 and V 827.

This trigger signal is routed via a Schmitt-trigger formed by D 802 (12-13-15), R 2662 and R 2664.
The gap of the Schmitt-trigger is 50 mV. Only when TTL mode is selected the trigger signal will be routed via a Schmitt-trigger which is formed by D 802 (10-11-14), R 2661 and R 2663. The gap of this Schmitt-trigger is 120 mV. The signal paths are selected via transistor V 831 which is controlled by the trigger mode selector switch S20.
In TTL mode, transistor V 831 is blocked by a −11,4 V on its base. Its collector is high and the signal path via Schmitt-trigger D 802 (10-11-14) is opened, the other one blocked. In the DC, HF and LF mode, transistor V 831 conducts by a positive voltage on its base via R 2669 and R 2672. The signal path via Schmitt-trigger D 802 (12-13-15) is opened and the other one blocked. The resulting MTB trigger signal on the output 14 of D 802 is applied to the "Event counter" and also to the main time-base sweep gating logic if no "Events before MTB" is selected with switch S 25 B.

If "Events before MTB" is selected with switch S 25 B, transistor V 832 will be blocked. This results in blocking the MTB trigger pulse path via D 802 (2-4-5) to the main time-base sweep gating logic. The main time-base will now be triggered with the first DTB trigger pulse via D 802 (3-6-7) after COUNT READY is generated. The COUNT READY pulse is fed via D 1202 (10-11-14) to the D-type flip flop D 901 in the main time-base sweep gating logic.The COUNT READY signal is also applied to D 802-7 to block the DTB trigger signals as long as there is no COUNT READY signal.
If "Events before MTB" is selected, the DTB trigger signal path to the delayed time-base sweep gating logic is blocked via a control signal to diode V 1225.
When "Events before MTB" is not selected, will transistor V 832 conduct. This results in blocking the DTB trigger signals and the COUNT READY signal.
The MTB trigger signal is passed through to the main time-base sweep gating logic, input 10 of D 901 is continuously "high" and the main time-base functions in the normal way.

3.2.3. Main time-base generator

The main time-base generator comprises a sweep gating logic, a sweep generator, a hold-off circuit and an auto sweep circuit.

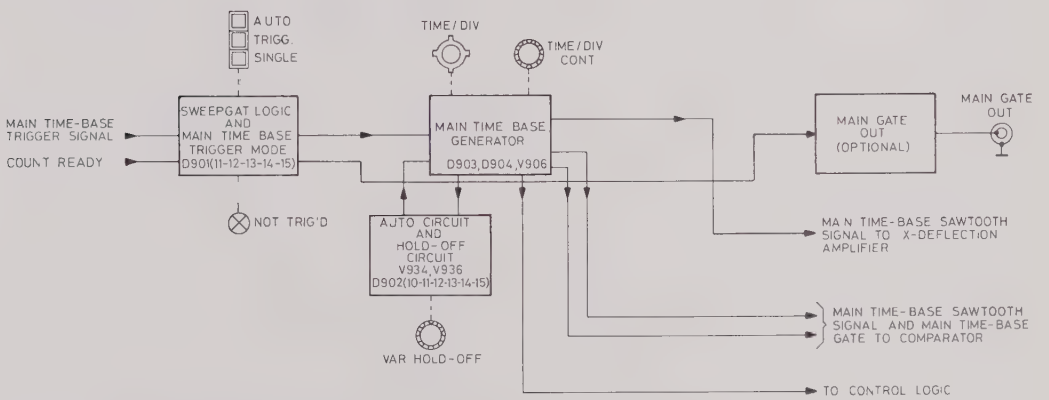

Fig. 3.6. Main time-base generator

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The operation of the main time-base generator is based on the principle that a capacitor charges linearly when a constant-current source is applied, and can be periodically discharged rapidly by means of an electronic switch. In this way, a linear saw-tooth waveform is generated.

The constant-current source consists of transistors V913, V914 and integrated circuit D903. The emitter voltage of V914 has the same potential as point 3 of D903, therefore a constant voltage exists across the series circuit of R926 and the charging resistors on switch TIME/DIV S15. This voltage, and thus the charging current may be varied by means of potentiometer R11 and the preset potentiometers R911 and R913, which compensate for the tolerances of the timing capacitors.

In the TRIG. position V931 is switched off because of the +5,2 V applied to its base by switch S8 (AUTO). If point 14 of the master slave flip-flop D901 is logic "high" due to a trigger pulse, V929 will also be switched off.
Consequently, its collector will be negative and switching transistors V906, V907 will be turned off (discharge switch open) and the timing capacitors C916 and C917 in parallel (and C912, C913 or C914 as selected) will be charged. This charging voltage is applied via the buffer stage consisting of the Darlington pair emitter-follower V922, V923 (h.f. path) and via the operational amplifier D904 together with V924 (l.f. path) to point 12 of the R; S; flip-flop D902. This flip-flop reaches its switching voltage when the time-base-saw-tooth voltage rises to approximately +4,3 V. Output 14 will then be "high" and output 15 will be "low". Since the collector of V937 is positive (see operation of AUTO circuit), diodes V927 and V926 will conduct and the "high" output on point 14 of D902 will be applied to point 12 (S input) of flip-flop D901. This results in a "low" output on point 14 of D901 irrespective of the state of the other inputs. The "low" output causes V929 to start conducting and its collector becomes less negative. Consequently, switching transistors V906, V907 conduct (discharge switches closed), the timing capacitance is discharged and point 12 of D902 drops below the switching level. Transistor V944, the base of which was turned on by the "high" output (point 14) of D902, is now switched off.
In turn, transistor V956 (discharge switch for the hold-off circuit) is switched off and allows the hold-off capacitance (C928 and C926, C927 as selected) to be charged by current source V954, D906. The voltage on point 3 of D906 is derived from a resistor that carries the charging current of the time-base generator. Therefore, the charging current for the hold-off capacitance is proportional to that for the time-base capacitance, thus giving a constant relationship between time-base length and the hold-off time. Potentiometer R18 (HOLD-OFF) allows the length of the hold-off period to be increased by a factor of 10. When the voltage across the hold-off capacitance has risen to a value of approximately 4,3 V the flip-flop D902 will be switched to its original state (outputs 14 low, 15 high), via buffer stage V949, V948. The "low" state on the base of V944 causes it to conduct and turn on V956 to discharge the hold-off capacitance. As a result, point 10 of D902 drops below its switching level. The S input of D901 will also be low again, whereupon the clock input (point 11) will be effective. The D input (point 10) is coupled with a logic zero or the COUNT READY signal depending on the setting of the EVENT BEFORE MTB or DTB switches S 25 A and S 25 B. Due to this pulse the flip-flop is switched over, resulting in a low level on point 15 and a high level on point 14 to permit the new time-base sweep.

3.2.3.1. Free run AUTO-circuit

If as a result of a trigger pulse, the Q output (point 15 of D901) is low, V934 and V936 start conducting and provide a discharge path for capacitor C923. Resistor R957 has been selected so that the current through R958 is insufficient to bring the base-emitter voltage of V936 to 0,7 V; therefore, both transistors are cut off as soon as C923 has discharged, provided that the Q output has switched to "high" in the meantime. The voltage on the negative side of C923 is then approximately +3,5 V and V937 is turned off, as a result of which diodes V926 and V927 are able to transfer the pulse on D902 output 14 to input 12 of D901.
Transistor V931 is turned off because its base is held at +5,2 V via R959, R960 and R962 (switch S8 (AUTO) is interrupted in the AUTO position). Thus, with a trigger signal input the time-base operates in the same way as in the TRIG position.

However, in the absence of a trigger signal, when D901 output 15 is "high", capacitor C923 will be slowly charged to approximately −6 V. If before this charging time (0.1 s approx.), point 15 turns to "low" (due to a trigger signal), C923 is discharged again before V937 starts conducting. As a result, V937 remains switched off and the instrument is still triggered.

If the voltage across C923 is permitted to charge to −6 V (i.e. no trigger signals appear), V937 starts to conduct and the resulting negative on its collector blocks diodes V926 and V927. At the same time, the base voltage of V931 drops. Consequently, the pulse on output 14 of D902 is no longer transferred to input 12 of D901, but is fed direct to the switching transistors V906, V907 via diode V932 and transistors V931 and V929.

In this way, the time-base generator runs automatically without the intervention of a trigger pulse. Transistor V937 is conductive when the time-base generator is not triggered. The base of V939 is then low, as a result of which the transistor conducts and the NOT TRIG'D lamp (V2) lights.

3.2.3.2. SINGLE SHOT mode

In the trigger position SINGLE, the time-base hold-off capacitors are short-circuited by diode V953 and switch contacts S8 (AUTO) and S8 (TRIGG).
The flip-flop D902 must then be reset manually by the RESET button S8 (SINGLE), which applies +5,2 V via R975, V946 to input 10. After input 10 has been brought to a high level and the RESET button released, triggering can occur, but on one event only as the flip-flop is not reset automatically.
In the SINGLE mode, V937 is permanently turned off via R965 by S8 (AUTO) and S8 (SINGLE). Since diodes V941 and V942 are now conductive, the pulse on output 14 of D902 will be transferred to the base of V939.
Consequently, the NOT TRIG'D lamp will light during the period when output 14 of D902 is low, i.e. from the moment the RESET button is pressed until the end of the time-base sweep initiated by the incoming trigger pulse of the event under observation.

3.2.4. Delayed time-base triggering

The trigger source switches for triggering the delayed time-base generator, can select any of the following input sources.

- an internal signal from the vertical A channel
- an internal signal from the vertical B channel
- an internal signal derived from the main time-base to start the delayed time-base immediately after the selected delay time
- an external source

Source selection is done by means of a trigger selector switch S21.

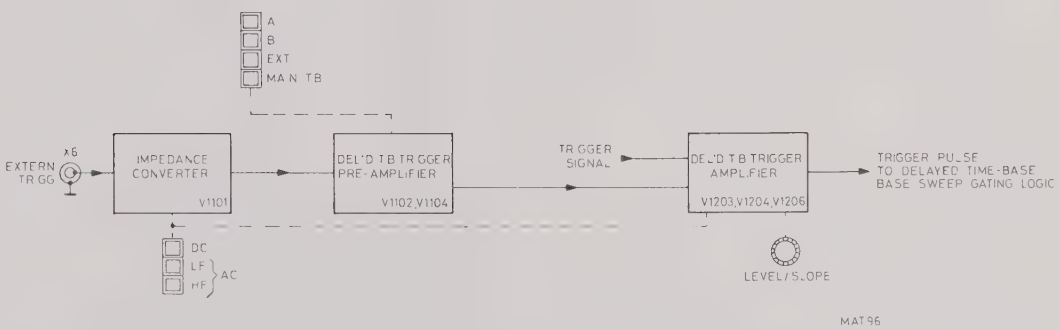


Fig. 3.7. Delayed time-base trigger circuit.

3.2.4.1. Delayed time-base trigger source selector and preamplifier

The signal which is applied to the external trigger input X6 is fed via the input stage consisting of FET transistor V1101 and integrated circuit D1101 to the base of V1104.
When DC coupling is selected with switch S19, a DC path is formed via the resistors R1103 and R1104 to input 3 of D1101. In the LF and HF mode the DC path is blocked. The l.f. component of the signal is fed via capacitor C1102 to point 3 of D1101 and the h.f. component is then fed via capacitor C1101 to FET transistor V1101. The output signal from V1101 and D1101 is then applied to the base of transistor V1104.

In the modes A, B and MTB the emitter of transistor V1102 is connected to the +11,4 V via switch S21, transistor V1102 is conducting thus blocking the signal path via the diode V1103.
When mode EXT is selected, there is no voltage applied via S21 to the emitter of transistor V1102. This transistor is blocked and the signal path via diode V1103 is opened.

The gain of the low frequency path is set by adjusting the resistor divider ratio from which the output is sampled. Adjusting is done with preset potentiometer R1118 (L.F. corr.).

3.2.4.2. Delayed time-base trigger amplifier

The delayed time-base trigger amplifier consists of an input stage, coupling filters and a final amplifier.

The signal current from the intermediate amplifier (channel A, channel B or composite) is fed via the trigger source selector circuit to the emitter of V1203. The output from the trigger source (EXT) is also fed to the emitter of V1203.
This transistor connected in common-base configuration, is coupled to the shunt feed-back stage V1204, V1206. The output of this stage is diode-coupled to the filters for the various coupling modes.
By means of these filters, the input frequency range of the trigger circuit can be set.
The desired filter is switched in by biasing the appropriate switching diodes in the forward direction via two resistors. For example, the DC and TTL position, selected by switch S19, are switched in by the −11,4 V which causes diodes V 1209 and V 1213 to conduct. The LF and HF modes are selected in a similar way.

The filter section is coupled to an emitter-follower V1214, which compensates for the temperature drift of transistor V1204.

The two transistors V1237 and V 1238 accept the trigger signal and the trigger LEVEL voltage respectively.
The LEVEL voltage control R5 permits variation of the trigger level of the signal.
The collector currents of V1216 and V1217 are fed to the shunt feedback stage V1219 and V1218 respectively, thus providing the trigger signal.

In the negative position of the +/− SLOPE switch S6, the trigger signal is taken from one of the collectors via V1224 and diode V1223, and in the positive position via V1221 and diode V1222.

+/− SLOPE switch S6 determines the polarity of the trigger signal. In the closed position a 0 V signal causes V1223 to conduct the negative trigger, and also switches off V1228. In the open position, V1228 is switched on and the positive trigger is routed via V1222 and V1223 is blocked.
In this way the appropriate trigger signal appears at the combined emitters of transistors V 1222 and V1223.

This trigger signal is routed via a Schmitt-trigger formed by D 1203 (12-13-15), R 1279 and R 1281.
The gap of the Schmitt-trigger is 50 mV. Only when TTL mode is selected the trigger signal will be routed via a Schmitt-trigger which is formed by D 1203 (10-11-14), R 1277 and R 1278. The gap of this Schmitt-trigger is 120 mV.
The signal paths are selected via transistor V 1226 which is controlled by the trigger mode selector switch S19.
In TTL mode, transistor V 1226 is blocked by a −11,4 V on its base. Its collector is high and the signal path via Schmitt-trigger D 1203 (10-11-14) is opened, the other one blocked.
In the AC, HF and LF mode, transistor V 1226 conducts by a positive voltage on its base via R 1289 and R1284. The signal path via Schmitt-trigger D 1203 (12-13-15) is opened and the other one blocked.
The resulting DTB trigger signal on the ouput 14 of D 1203 is applied to the "Event counter" and also to the delayed time-base sweep gating logic if no "Events before DTB" is selected with switch S 25 A.

If "Events before DTB" is selected with switch S 25 A, transistor V 1227 will be blocked. This results in blocking the DTB trigger pulse path via D 1203 (3-6-7) to the delayed time-base sweep gating logic. The delayed time-base will now be triggered with the first DTB trigger pulse via D 1203 (3-6-7-) after COUNT READY is generated. The COUNT READY pulse is fed via D 2403 (12-13-15) to the D-type flip flop D901 in the delayed time-base sweep gating logic. The COUNT READY signal is also applied to D 1203 - 4 to block the DTB trigger signals as long as there is no COUNT READY signal.

3.2.5. Delayed time-base generator

The delayed time-base generator comprises a sweep gating logic, a sweep generator, a comparator and an end of the sweep detector.

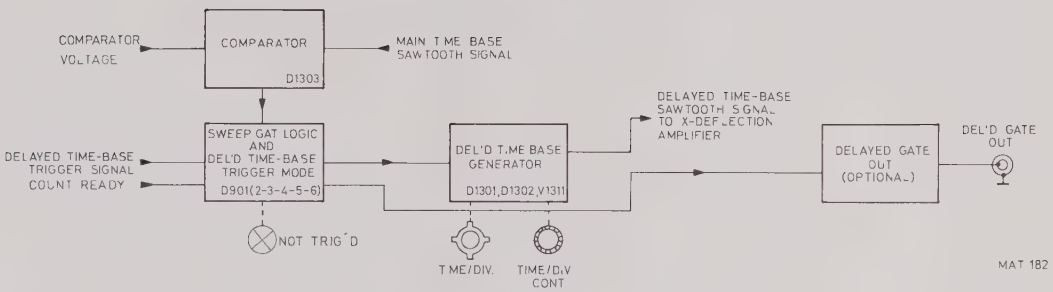


Fig. 3.8. Delayed time-base generator

Before considering these stages in detail, the general principle is briefly described.
Basically, the sweep gating logic, under the control of trigger signals from the trigger circuit and also feedback pulses from the end-of-the-sweep detector circuit, supplies square-wave pulses to the switching transistors V1309 and V1311 of the sawtooth generator. The time-base capacitors (effectively in parallel with the switching transistor) are charged linearly through a constant-current source to provide the forward sweep, and are discharged rapidly by the switching transistor to provide the flyback period. The resulting sawtooth is fed via the X-deflection selector to the X-final amplifier.

3.2.5.1. Delayed time-base sweep generator

The sweep speed or time coefficient is determined by the value of the time-base capacitance in circuit, and also by the magnitude of the charging resistor selected.
The time-base capacitors C1311, C1312 are always in circuit, the capacitors C1307, C1308 and C1309 are selected by the transistors V1319, V1322 and V1323 respectively. These transistors operate as electronic switches and are either fully cut-off or fully-conducting. They are switched on by the application of a positive voltage on their bases from the TIME/DIV switch S13. According to the position of S13 the transistors switches in one of the capacitors in parallel with C1311 and C1312.
As mentioned, the sweep speed is also dependent upon the magnitude of the accurate constant-current supplied by transistors V1317 and V1318. This current can be adjusted in steps by selecting the emitter resistance of V1318 by means of the TIME/DIV switch S13.

Continuous control of the charging current can be effected by varying the drive to point 3 of integrated circuit D 1301 with the continuous sweep control, TIME/DIV potentiometer R10.
Potentiometer R1326 enables the sweep speeds of the delayed time-base generator to be equalized to those of the main time-base generator.
Together with C1307 and C1309, transistors V1314 and V1312 are switched into the circuit by a +5,2 V voltage from the TIME/DIV switch S13. In these positions potentiometers R1323 and R1322 provides a fine adjustment for the timing circuit.
The discharge circuit for the time-base capacitors consists of transistor V1311, which is driven by the sweep gating logic.
The resulting sawtooth voltage is fed via an l.f. path and an h.f. path to the X-deflection selector. The l.f. path consists of integrated circuit D1302 and transistor V1328 and the h.f. path consists of transistors V1326 and V1327.

3.2.5.2. Delayed time-base end of-the sweep detection circuit

This circuit prevents the sweep gating logic from responding to trigger pulses before the time-base capacitor has fully discharged. The sawtooth output is applied to point 7 of SR flip-flop D902.

At the end of the time-base sweep, output 2 of the SR flip-flop D902 will be "high" and output 3 will be "low". These logic levels are transferred to pins 5 and 4 respectively of D901 irrespective of the state of the comparator D 1303. As a result, the $\overline{Q}$ output point 3 becomes "low" and the timing capacitors are discharged via V1311, since the flip-flop D902 is not reset until the end of the main time-base sweep (D902-15 on MTB connected via a differential network to D902-5 on DTB). This situation will persist until the next sweep of the main time-base. If the main time-base sweep is completed before the end of the delayed time-base, the R and S inputs (5 and 4) of D901 are switched over and the delayed time-base capacitors also are discharged.
The system can now be triggered again.

3.2.5.3. Comparator circuit and sweep gating logic

The comparator consists of an integrated circuit D 1303. Transistor (points 6-7-8) is a constant-current source for the transistors (points 1-2-3 and 3-4-5-) of a differential amplifier.
The comparator voltage generated by the dual d.a.c. circuit is fed to the base of transistor (points 3-4-5). The sawtooth voltage of the main time-base generator is fed to the base of the other transistor. As soon as the amplitude of the sawtooth exceeds the comparator voltage, a high level is passed from D 1303, pin 5, to input 4 of master-slave flip-flop D901 (R input), and a low level from D 1303, pin 1 to S input 5 of D 901.
The $\overline{Q}$ output on point 3 will then be high, with as result that V 1304 and the time-base capacitor discharge switches V 1309 and V 1311 will be turned off. This is the situation in the MTB position of the switch S21.
In positions A, B or EXT of delayed time-base trigger selection switch S21, point 4 of D 901 can be switched to logic O level via switch S 21 and diodes V 2554 or V 2556. (Not possible when event before MTB is selected with S25). The delayed time-base then starts first upon receipt of trigger pulses on clock input 6, after the S input has dropped to the low level.

3.2.5.4. Dual D.A.C.

In the MAIN TB position of the delayed time-base trigger selection, the sawtooth voltage generated by the main time-base is compared with a d.c. voltage produced by the dual D.A.C. that is proportional to a number put into the memory of the micro-processor by means of the SET control.
The number put into the micro-processor memory is from 0 to 2000 and it corresponds to the delay required on the time-base; i.e., 0 represents no delay and 2000 represents maximum delay. In relation to the divisions on the c.r.t. screen, as 2000 represents 10 divisions, each division is occupied by 200 increments.

If the ΔT mode is selected, then the dual D.A.C. produces two d.c. voltages to provide starting times for the two delayed time-bases during the MTB sweep.
These two voltages are fed alternately to the comparator to produce the two delayed time-base displays. Following alternate sweeps of the main time-base, the 1st delayed time-base is displayed, and then the 2nd delayed time-base.

In the dual D.A.C. circuit, the two d.c. voltages are formed by a pulse-width modulator circuit using the four Up/Down counters D2601, D2602, D2603 and D2604.

Using fixed-frequency pulses derived from the clockpulse of the microprocessor, the pulse width of the output from these counters is varied as a function of the number stored in the memory.
This variable pulse width is made as follows:
Each of the four digits of the total-delay number 2000 is served by one of the four counters, integrated circuits D2601 to D2604, where D2601 serves for the most-significant digit and D2604 for the least-significant digit.
As the maximum count is 2000, the most-significant digit counter D2601 only counts the number 0, 1 or 2.
Counting is achieved in repetitive cycles of four steps.

Step 1 — the microprocessor loads these counters with the number representing the 1st delay time and counts from it up to 2000.

Step 2 — the microprocessor loads these counters with the number representing the 1st delay time and counts from it **down** to 0.

The total number of count pulses in these two steps is 2000 independent of whatever delay time is chosen; i.e. the frequency of these two steps is always the same.

Step 3 — the microprocessor loads the counters with the number representing the difference between the starts of the two delayed time-bases; i.e., ΔT, and counts from it **up** to 2000.

Step 4 — the microprocessor loads the counters again with ΔT and counts from it **down** to 0.

As in steps 1 and 2, the total number of count pulses in steps 3 and 4 are 2000.

In this way, we have pulses of fixed frequency, with a variable pulse-width from 0 to 50 % depending on the selected delay times.

The counter D2603, D2603 and D2604 produce a MIN/MAX high output when the numbers they contain reach 0 in the count-down mode and 9 in the count-up mode.
These outputs together with the CLOCK provide inputs for an AND gate comprises of diodes V2601, V2602, V2603 and V2604. Therefore, when all M/M outputs and the clock are present (all counters 0 or 9) a MIN/MAX total, or terminal count, pulse is present on input 5 of NAND gate D2607.

As the maximum number counted is 2000, as stated, the most-significant digit is only 0, 1 or 2. Counter D2601 has therefore two spare bits left, which are used to give information about the four counting steps.
Input D7 is used to give mode information, whether delay mode (logic 1) or ΔT mode (logic 0).
Input D6 gives count up (logic 0) or count down (logic 1) information.

NAND gates D2607 provide a terminal count output pulse (logic 0) on points 6 and 8 at the end of every step.

End of steps 2 and 4 - terminal count (logic 0) on point 6 of D2607

Input conditions:

Q6 **down** pulse logic 1 to point 1 of D2607
Logic 0 on Q4 [1 (000) bit output] via inverter as logic 1 to point 4 of D2607
Logic 0 on Q5 [2 (000) bit output] via inverter as logic 1 to point 2 of D2607

MIN/MAX total logic 1 to point 5.

End of steps 1 and 3 - terminal count (logic 0) on point 8 of D2607

Input conditions:

Q6 **up** pulse logic 0 via inverter as logic 1 to point 9 of D2607
Logic 1 on Q5 to point 10 of D2607.
(+5 V on pin 13) of D2607.

This terminal count pulse is routed together with the mode information (delay or ΔT) via gates D2606 and D2608 to the flip-flops D2609 to produce fixed-frequency pulses with widths proportional to the delay or ΔT times.

The method of producing these pulses is best understood by taking specific examples.
Assume therefore a delay of 500 increments and a ΔT of 200 increments.

Step 1 (Delay Up) — The microprocessor loads the counters with the delay time, 500 in this example, and during this step counts up to 2000.
As we are in the delay mode, the Q7 output of D2601 is at logic 1. Reset input R2 of D2609 is also at logic 1 and so is inactive.
The set input S2 is also at logic 1 (inactive) because although there is a "1" on point 4 of NAND gate D2608, in the absence of a terminal count pulse, there is a "0" on point 5.
As seen in Fig. 3.9., there is therefore no pulse on the Q2 output to produce the delay voltage pulse.
However, as the counter reaches 2000, a terminal count pulse occurs, and a logic 0 on output 8 of D2607 is inverted by D2606 points 13 to 12) to give a logic 1 on input pin 5 of NAND gate D2608. Together with the logic 1 on input 4 of gate D2608, this produces a logic 0 output to activate the set input S2 of the set/reset flip-flop D2609. This initiates a positive-going pulse on the Q2 output.

Step 2 (Delay Down) — The micro-processor loads the counters again with the delay time, 500, but during this step it counts down to 0 and, as seen in Fig. 3.9. we get a positive pulse on Q2 of width proportional to 500. At the end of the step the output on Q7 drops to logic 0 and S2 goes to logic 1 (logic 1 on D2608 output 6, R2 goes to logic 0 and consequently the pulse on Q2 drops to logic 0.

Step 3 (ΔT Up) — The counter is now loaded with the ΔT, in this example 200, and during this step it counts up to 2000.
In this mode, output Q7 of D2601 is at logic 0.
Reset input R1 is at logic 1, and is therefore inactive, because of inverter D2606 (point 9 to 8).
The set input S1 is also at logic 1 (inactive) because although input 1 of gate D2608 is at logic 1, in the absence of a terminal count pulse, input 2 is at logic 0.
As this step reaches 2000, there is a terminal count pulse and the set input S1 becomes low. This activates the lower flip-flop and initiates a positive-going pulse on the Q1 output as shown.

Step 4 (ΔT Down) — The counter is again loaded with the ΔT pulses and counts down from 200 to 0. For the duration of this step there is a positive pulse output from Q1.

During the four steps of the cycle, the set/reset flip-flops D2609 produce one pulse on Q2 and one pulse on Q1. Pulse Q2 has a duty cycle that is proportional to the 1st DTB delay and Q1 has a duty cycle that is proportional to the time ΔT between the start of the 1st and 2nd delay time-bases.
Both pulses can be selected to have pulse-widths of between 0 and 50 % (max. 2000 count pulses at a total of 4000).

The delay pulse on Q2 is integrated by RC filters R2609, C2601, R2611, C2602, R2612, C2603 and fed to input 3 of integrated circuit operational amplifier D2611.
The ΔT pulse on Q1 is integrated by RC filters R2621, C2604, R2622, C2606, R2623, C2607 and fed to input 3 of operational amplifier D2612.
The outputs from Q2 and Q1 are approximately +5 V, and as the maximum duty cycle is 50 % the voltages on input 3 of D2611 and D2612 are from 0 to 2,5 V depending on the pulse widths.
As the time-base sweep is 0,5 V per division, then the ten divisions require 5 V, so the operational amplifiers D2611 and D2612 have a gain of x2 each.

Zero adjustment potentiometers R2602 (delay) and R2613 (ΔT) ensure that the start of the time-base coincides with the minimum voltage. The amplification of the operational amplifiers can be adjusted by potentiometers R2606 (delay) and R2617 (ΔT), to ensure that the maximum comparator voltage coincides with the end of the main time-base trace.

Half of the delay voltage on output 6 of D2611 is combined in potentiometer R2626 with the ΔT voltage on output 6 of D2612 and fed to input 3 of the operational amplifier D2613 which has also a gain of 2. The output of D2613 now has a voltage that represents delay + ΔT; i.e. the 2nd delayed time-base voltage.

Two d.c. voltages are now available for the two delayed sweeps and can be alternately switched to the comparator via V2614 (for DELAY and ΔT) and via V2606 (for DELAY) by means of the ALT pulse.

The ALT pulses are routed to points 1 and 2 of inverter D2617 to the trigger input of JK flip-flop D2618, and are also routed to input 4 of NAND gate D2617.

There are several possible modes of operation.
If only the 1st delayed time-base is required, then the delay output voltage on point 6 of D2611 is routed via V2606 to the comparator. Field-effect transistor V2606 conducts when its gate is high; i.e., when output 6 of the flip-flop D2618 is low, because V2609 inverts the output. This is achieved by a high input on K3 of D2618 from the ΔT switch (non-operated). In the 1st delay mode, the high output on point 8 of D2618 blocks V2614 via inverter V2613.

Zener diodes V2607 and V2611 compensate for the difference in voltage levels between the flip-flop outputs and the bases of the inverters V2609 and V2613.

The input on point 5 of D2617 and point 9 of flip-flop D2618 is dependent on the position of the ΔT switch. If this switch is depressed it is at logic 0. In the normal position the input is logic 1, then also p.8 of D2618 is logic 1. The ALT pulse from the main time-base goes then straight through the two D2617 gates to the logic unit.

When the ΔT switch is operated, both the 1st delay and the 2nd delay are available, and point 9 of D2618 becomes logic 0.
At every transition of the time-base flyback the flip-flop D2618 changes over, so that output points 6 and 8 are alternately switched between "0" and "1". Therefore, at every flyback period point 8 changes state, and has half the repetition rate of the MTB gate pulse.
This pulse is fed to point 9 of D2617 together with a "1" from D2617 output 6 to give an output to the pt 13 of D1608 of the alt. time-base logic.

The time-base switching sequence is:

- main time base with 1st delayed time-base intensified
- main time base with 2nd delayed time-base intensified.

The micro-processor receives a pulse (logic 1) from the set/reset flip-flop D2608 (comprising two NAND gates), via inverter D2669 (points 9, 10 to 8) to inform it that counting is complete.

Every cycle gives a "0" output (terminal count) pulse on points 6 or 8 of D2607, which is fed to input 10 of flip-flop D2608.
Point 8 becomes a logic 1 and normally point 13 is at logic 1, so the output point 11 is at logic 0. The inverter D2669 (points 10, 9 to 8) gives logic 1 to the RESTART 7,5 input of the micro-processor (point 7). This pulse starts a program which loads the new cycle of this counter circuit.

Therefore, when there is a terminal count, there is an interrupt of the micro-processor, which immediately answers the interrupt. In this way, counting can be continuous. When an interrupt is given, there is a delay while the micro-processor checks which cycle is occurring and loads these two counters.

The counters are loaded in two steps:

Load 1 The least-significant digit counters D2603 and D2604.

Load 2 The most-significant digit counters D2601 and D2602.

When the most-significant digit counters are being loaded, the negative pulse makes input 13 of flip-flop D2608 logic 0, and the flip-flop resets and RST 7,5 goes to 0.
After the load pulse is complete, input 13 becomes logic 1.

During a restart interrupt, the logic 0 on point 11 of D2608 is also fed to the four set/reset flip-flops (tri-state input 5) to isolate the outputs, so that the capacitors of the RC networks have no discharge path during an interrupt.

If there is an interrupt and output 11 of D2608 is at logic 0, and output 8 is at logic 1, the enable input of the first counter D2604 becomes logic 1, and therefore the counter is blocked; i.e. it is disabled.
Disabling the first counter is sufficient to disable all the counters, as these counters are enabled by the ripple clock (RC) of the first counter (point 13). The ripple clock of the least-significant digit counter feeds the enable input (EN) of the next-significant counter, and so on.
The μP's clock signal on input 1 of D2669 is gated with the Load 2 signal in order to prevent that the enable input of D2604 changes if the clock input is low.

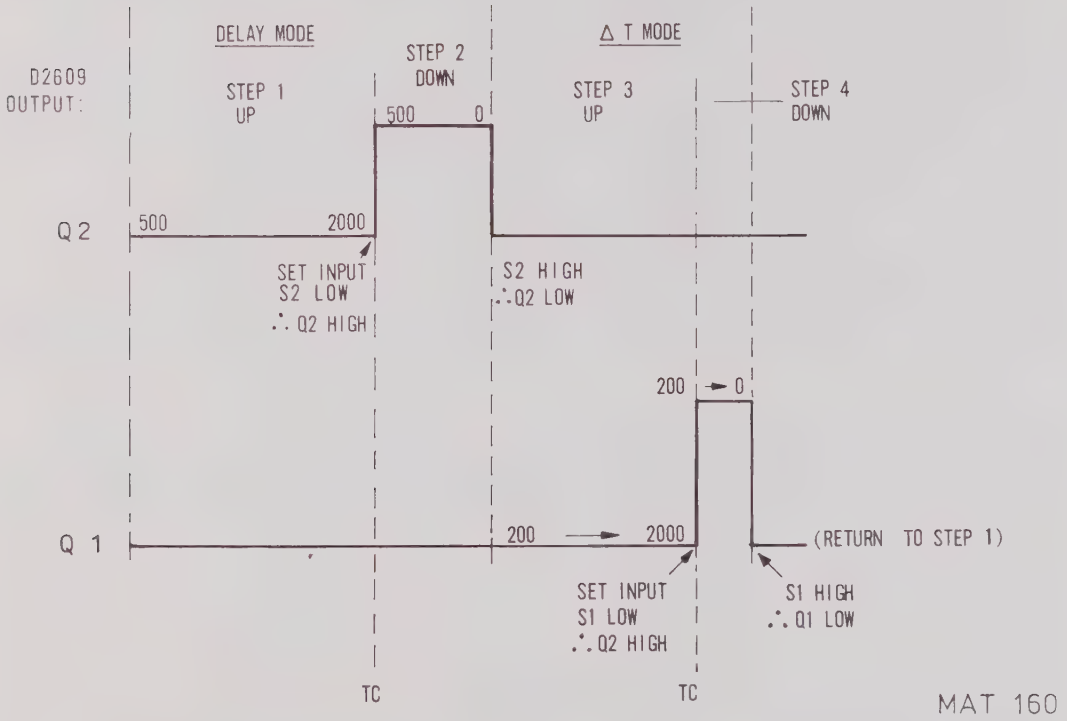


Fig. 3.9. Pulse diagram dual d.a.c.

3.2.6. Microprocessor circuitry

Introduction

Fig. 3.10. shows a blockdiagram with all circuits which are under control by the microprocessor.

From left to right on this diagram is indicated:

– *Control interface*

This circuit interpretes to the microprocessor the positions of the various front panel knobs and switches.
The outputs of this interface is applied to the data bus.
The interface is selected by address lines A_0 and A_1, combined with the $\overline{IOR}$ signal.

– *ROM memory*

A 2-k 8-bit read-only memory which contains the working program for the micro-processor. There is one spare socket for eventual memory expansion.
The specification address is selected with address lines A0 -- A10 and the ROM memory itself is selected via its chip select input $\overline{CS}$ by address line A12, combined with the memory read signal MEMR. (= $\overline{A13}$. RD)

$$CS = \overline{A12} \,.\, \overline{A13} \,.\, RD$$

The spare ROM is selected by address line A11 and the memory read signal MEMR.

$$CS_{SPARE\ ROM} = A11 \,.\, \overline{A13} \,.\, RD$$

– *RAM memory*

A 1/4-k 8-bit read/write memory, consisting of 2 chips 1/4-k 4-bit, which is used for temporary storage of various data which are used by the microprocessor.
The specification address is selected by the address lines A0 ... A7.
The RAM's are selected by address line A12 on the chip enable inputs $\overline{CE}$ and are controlled by the MEMW and MEMR signals.

Write if A12 . $\overline{A13}$. WR = 1
Read if A12 . $\overline{A13}$. RD = 1

– *Microprocessor*

The microprocessor has 8 data lines and 16 address lines.
The first 8 address lines A0 ... A7 are combined with the data lines D0 ... D7. These lines are called AD0 ... AD7.
Depending on the logic level of the ALE signal the AD0 ... AD7 lines contain an address or data.
The data bus (8 data lines D0 ... D7) is connected to the microprocessor via two 4-bit bi-directional buffers.
The address lines AD0 ... AD7 are connected to the address bus via two 4-bit latches which can take over address information, depending on the logic level of the ALE signal.
To prevent a too heavy load of the outputs of the microprocessor chip, the address lines A8, 9, 10, 13 and the ALE and CLOCK signal are buffered.
The address lines A14 and A15 are used for addressing a VCO and a watch-dog circuitry respectively.

– *Event counter*

The event counter is used in the "Events before DTB", and "Events before MTB" modes.
The string of dividers by 10 is preloaded with a certain number by the microprocessor via latches. These latches are loaded by the microprocessor via the data bus and are selected by the address lines A0 ... A1 and A2 combined with the IOW signal.

– *Dual d.a.c.*

This circuit consists in principle of an up/down counter which produces a square wave signal.
The duty cycle of this signal depends on the value which is loaded into the counter by the data bus.
The square-wave signal is integrated to obtain the desired comparator voltage, to start the delayed time-base
This circuit is selected with address lines A3 and A4 combined with the IOW signal.

– *LED display*

The transistor circuitry which drives the 7-segment display is controlled by two latches for segment selection and one addressable latch for digit selection.
The latches are selected by address lines A5 and A6 respectively and the IOW signal.
The latches are loaded via the data-bus.

The microprocessor circuit works in memory-mapped I/O configuration.
Refer to Fig. 3.11.

3.2.6.1. CONTROL INTERFACE

In order to operate appropriately, the microprocessor must have information about the positions of the front panel switches and controls.
To achieve this, three 8-input/2-output multiplexers D2451-D2452 and D2453 can be addressed by the micro-processor address-lines A0 and A1.
The multiplexer's inputs are given to the microprocessor on datalines D0 ... D5 if the signal $\overline{IOR}$ = 0.
With $\overline{IOR}$ = 1, the multiplexer's outputs are high ohmic.

The information is fed to the microprocessor according to the table below.

A1	A0	D5	D4	D3	D2	D1	D0
0	0	TBG6	TBG5	TBG4	TBG3	TBG2	TBG1
0	1	TB uncal	TBS3	TBS1	TBS2	TBG8	TBG7
1	0	EXT X	Service Switch	MAIN TB	EVENT	DELAY	ΔT
1	1	DTB "OFF"	1/T	Push for FAST X 100	UP/ DOWN	(F)*	(L)*

If the switches are "on", then the inputs of the multiplexers are logic "0". The TBG.. and the TBS.. groups give information about the position of the MTB TIME/DIV switch.
The (L) and (F) inputs are only used in the PM 3263X (= TV version).

3.2.6.2. VOLTAGE CONTROLLED OSCILLATOR (V.C.O.)

The V.C.O. which is controlled by the SET knob R1 is used to adjust the following values:

- Delay time
- ΔT time
- Number of Events to be counted.

The V.C.O. consists of amplifier D2301-D.

V.C.O. "off"

With R1 (SET in the mid-position the potentials on pt.5 and pt.9 of amplifiers D2301-A and D2301-B are equal. Combined with the potential adjusted by R2302 it results in both inputs of NAND-gate D2302-A being high, and consequently the output of D2302-B is high. This brings input 11 of D2301-D at a potential which is always higher than the voltage on input 10 of D2301-D. A stable situation is thus obtained (pt. 13 of D2301-D is logic 1).

V.C.O. "on"

As soon as R1 (SET) is rotated out- of the mid-position, one of the outputs of D2301-A or D2301-B goes to zero which results in the output of D2302-B going to logic 0.
Now the voltage on point 11 of D2301-D is lower than the voltage on point 10 and the output pt.13 of this amplifier goes to logic 0. Consequently, the output of D2302-D goes to logic 0 and capacitor C2303 is discharged via R2323.

At the moment that the voltage on pt. 10 of D2301-D is lower than the input voltage on pt.11, the output of D2301-D goes to logic 1. Now C2303 is charged via R2312 until the voltage on pt. 10 exceeds the voltage on pt.11 of D2301-D and the output of D2301-D goes to logic 0 again, and so on.
Note that C2303 is not charged via R2323 because D2302 is an open-collector circuit.
The further R1 is rotated from its mid-position the faster C2303 is loaded and the higher the V.C.O. frequency. The V.C.O. frequency is even more increased if R1 is far from the mid-position because V2301 then becomes conducting and R2316 comes in parallel with R2312.
Adjusting potentiometer R2321 influences the voltage-gap at the input of D2301-D and thus the frequency of the V.C.O.
When R1 is rotated only a few degrees out of its mid-position the V.C.O. frequency will be very low. For

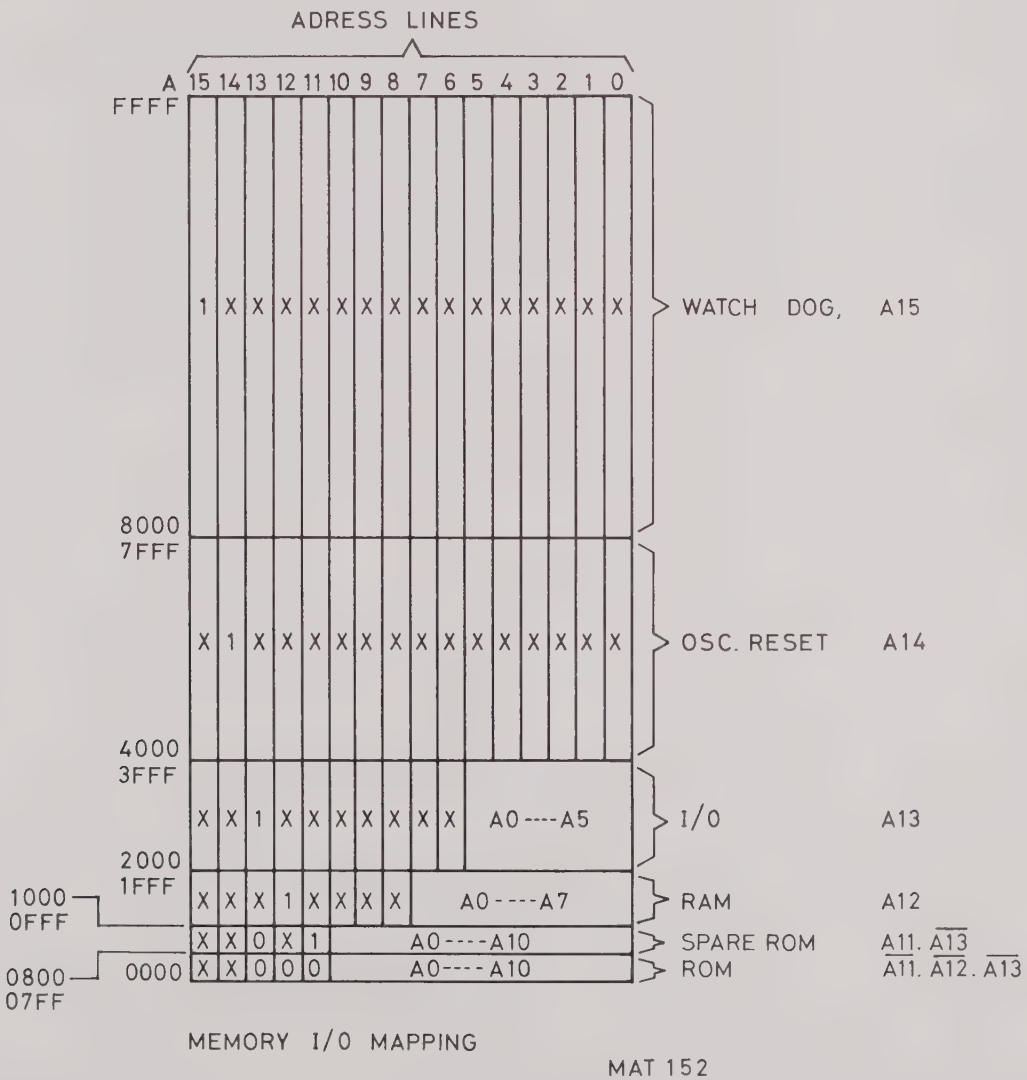


Fig. 3.11. Memory map.

convenience of operation one V.C.O. pulse is generated as soon as R1 is rotated out-of its mid-position.
As soon as the V.C.O. is switched-on the output of D2302-B jumps to logic 0, and via C2306 this appears as a negative pulse on input 11 of D2301-D. This results in one V.C.O. output pulse.
R2306 provides D2301-D with a certain positive feed-back to avoid unstable situations during switching over.
Note that if the SET knob is pushed (= frequency x100) nothing changes in the V.C.O. circuit. In this case the microprocessor gets the message to count in steps of hundreds in stead of ones.

Up/Down

The up-count, or down-count information is obtained with D2301-C. Both inputs of D2301-C are connected to the SET potentiometer.

3.2.6.3. EVENT COUNTER

The event counter allows the selection of the number of pulses that elapse before triggering (from 1 to 99999). This is achieved by using counters D2402, D2406, D2407, D2409 and D2411. Counter D2402 (ECL) is the LSB counter.
Briefly, it operates by putting the 9's complement of the selected event number into it. The counter is started and counts up until it reaches 99998. That means that it has counted all the events minus 1. At that moment, the triggering of the time-base is freed and the next pulse that is received triggers the time-base.
The 9's complement of the selected number of events is put into latches D2413-D2414-D2416-D2417 and D2418 by the microprocessor. Latches are selected by IOW and A0, A1 or A2.
The contents of the latches is only changed if the selected number of events has been modified (i.e. changing of the selected number of events cause an RST 6,5 interrupt to the microprocessor which modifies the contents of the latches).
The counters are preset by the latches at the beginning of the hold-off time after each time-base sweep.

Presetting the counters (Refer to Fig. 3.12.)

At the start of the hold-off period in D2404 a 200 ns pulse and a 100 ns pulse is generated, via V2401.

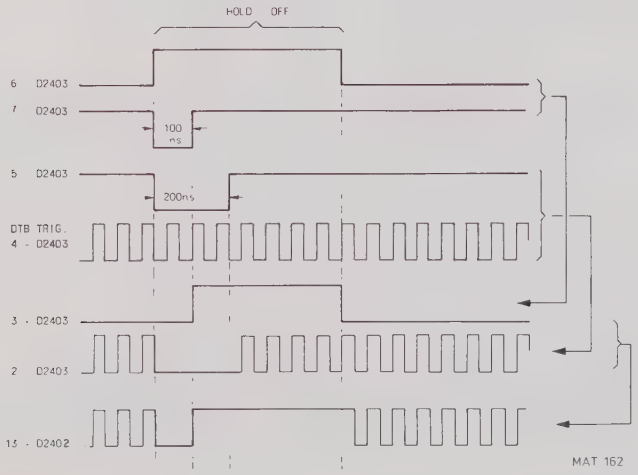


Fig. 3.12. Presetting the counters

The counters D2406, D2407, D2409 and D2411 are preset during the 200 ns pulse which is applied to the load input point 11 of these counters.
Counter D2402 receives the same 200 ns pulse (on its S2 input point 7) but requires during this pulse also a clock pulse (CL input point 13).
This clock pulse is the positive-going edge of the 100 ns pulse.

Counting

Counting is started on the first trigger pulse after the hold-off period of the main time-base.
The min./max. outputs of the counters (except D2402) will be at logic 1 when 99997 is reached. So via the AND gates D2408 a logic 1 is available on input 10 of NOR-gate D2419-A (output 14 will go to logic 0).
At the reset input point 4 of flip-flop D2401-B the count enable (logic 0) signal is present, coming from point 15 of flip-flop D2401-A.
As input 13 of OR-gate D2419-B is permanently at logic 0, and point 12 is now at logic 0, output point 9 will go to logic 0.
Point 3 of D2419-C is at logic 1 because counter D2402 has not yet reached the end of its count.
As soon as D2402 counts "8", the output point 3 of D2402 and also point 3 of NOR-gate D2419-C goes to logic 0.
Because of the wired- or function of D2419-A-B-C the COUNT READY signal which is applied to the time-base circuit is low as all 3 outputs 3, 9 and 14 are low.

On the eight pulse the COUNT READY signal will be at logic "0", but the counter D2402 continues counting and after two further pulses point 3 of D2402 will be at "0" and the counter goes back to zero to resume counting.
To retain the COUNT READY information, it is latched in flip-flop D2401-B via NOR-gate D2419-D.
The COUNT READY signal is inverted in by D2419-D to give a positive-going clock pulse to flip-flop D2401-B
The logic 1 on the preparatory input (point 7) of flip-flop D2401-B, gives a logic 1 on inputs 11 and 7 of D2419, thus the COUNT READY signal is retained.
After the sweep of the MTB, the flip-flop D2401-A is reset and the logic 0 signal COUNT ENABLE resets the flip-flop D2401-B.

The coupling of the first counter D2402 to the second one D2406, goes via the diodes V2403, V2406 and transistor V2407.
The circuit with V2403 and V2406 is used to provide a wider clockpulse for the next counter.
Transistor V2407 matches the ECL circuit D2402 to the TTL circuit D2406.

3.2.6.4. *DISPLAY UNIT*

The display unit indicates the selected delays on numbers of events before triggering. It comprises six 7-segment numerical LED displays and three LED's for EVent, DIVision and Sec or Hz.
Access to the individual digits by the microprocessor is achieved by the binary-decimal latch D2203. A T2 signal derived from IOW and address line A6 is send to the input E point 14 of D2203 and all eight output bits can be accessed by the relevant choice of data combination.
In turn the logic ones at the outputs 4, 5, 6, 7, 9, 10, 11 and 12 of D2203 cause the related drive transistor (V2221 to V2228) to conduct and connect the cathode of the display to the 0 V line. Only one latch is activated at a time, therefore only one cathode of the display is activated at a time. This provision is necessary because the segment information is present on all display digits.
Point 15 of D2203 gets +5 V via an RC filter R2218, C2204, which blanks the LED display during the very first moment of power-on.

In order to illuminate the appropriate display, anode currents must flow in the selected segments of the digit activated. All segments of the display are connected to a current source comprising eight transistors, V2211 to V2219 (7-segments +1 decimal point). These current sources are permanently on because of the current applied to their bases. The currents flow either into the connected segments of the selected display or into the switching transistors V2201 to V2209, that can be selected to conduct by the latches D2201 and D2202. Digit information is offered via the data bus lines D0 ... D7 to the latches D2201 and D2202. The information is taken over by the latches with the T1 signal which is derived from IOW and address line A5.
In this way, when a digit is selected for illumination by D2203; i.e. its cathode is connected to 0 V, the segment information from D2201 and D2202 causes the constant current to flow in the segments selected (by blocking the relevant drain transistors). The segments not selected for illumination are effectively by-passed as the constant current still flows in the remaining drain transistors. As each constant current flows through either a segment or a transistor the current drain remains the same irrespective of the number of segments illuminated.

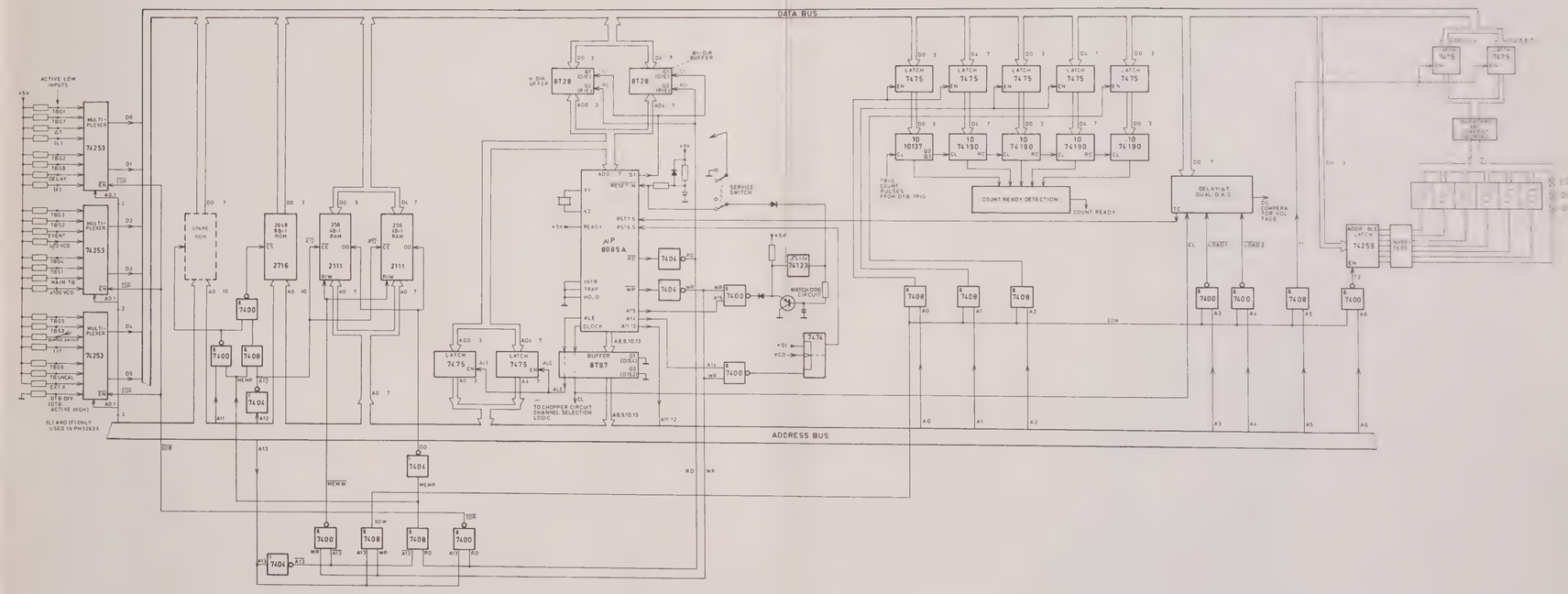


Fig. 3.10. Blockdiagram microprocessor and circuits which are under control of the microprocessor.

3.2.7. X deflection selector and alternate time-base logic

Depending on the selected position of X deflection source selector switch S2, the circuit provides for X deflection by the main time-base signal, the delayed time-base signal, a signal from an external source or X deflection by one of the internal signals derived from channel A, channel B or the mains voltage.
There is also the possibility to select the main and delayed time-bases alternately.

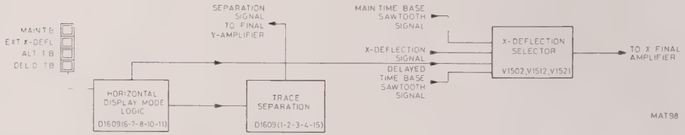


Fig. 3.13. X deflection selector and alternate time-base logic.

The different functions of the logic circuits are now described according to the horizontal display mode selector switch S2:

MTB

– When no pushbutton is depressed or when MTB is depressed flip-flop D1609 is set in the MTB position via its R and S inputs (output 10 is high).
The MTB pushbutton releases all the other push-buttons of the horizontal deflection mode selector, its contacts are not used.
In the MTB position of switch S2, transistor V1509, which is driven by output 10 of flip-flop D1609, and consequently transistor V1511, conduct. Diode gate V1513, V1514 is therefore opened and the main time-base output is applied via transistor V1512 to the X amplifier, via these diodes and R1703.
In this mode only the main time-base sawtooth signal is fed to the X final amplifier and not the delayed time-base sawtooth signal and the X-deflection signal.

DTB

– With DTB selected flip-flop D1609 is set to the DTB state via its S and R inputs (output 11 is high).
In the DTB position of switch S2, transistor V1501, driven by output 11 of flip-flop D1609 and consequently transistor V1506 are conducting. The diodes V1503 and V1504 conduct and provide a signal path for the output sawtooth signal of the delayed time-base generator to the X final amplifier. With DTB selected the main time-base signal and the X deflection signal are blocked.

EXT X DEFL

– In the EXT X DEFL position a +5,2 V is applied via switch S2 to the base of V1516, with a result that the base of V1517 exceeds +5,2 V and this transistor is turned off.
Transistor V1524 then starts to conduct via R1528 and diode V1523 (8,2 V), and the external signal for amplifier V 1519, V1520 and V 1521 is routed via the diode gate V 1522, V 1526 to the X amplifier.
When EXT X DEFL is switched off, transistor V1516 is turned off and transistor V1517 conducts via R1522. The collector of V1517 is therefore at +5,2 V, and as the voltage across diode V1523 is less than 8,2 V, this diode is blocked and transistor V1524 is turned off. In this position the X MAGN reed relay K1701 for the X1, X10, may be switched in. This is not operative when EXT X DEFL is switched on.

ALT TB

– With ALT TB depressed, the oscilloscope is set in the alternate time-base mode and the main and delayed time-bases are selected alternately.
ALT TB is not possible with DTB TIME/DIV switch S13 in the "OFF" position and with push-button TRIG VIEW of switch S1 depressed.
Switching over from MTB to DTB in ALT TB mode is achieved by switching in transistor V1509 and V1501 in turn via flip-flop D1609.
In ALT TB a +5 V signal is fed to input 4 of NAND D1606. With the delayed time-base switched off and with TRIG VIEW not depressed a 0 V signal appears at output 6 of NAND D1606. With this 0 V signal NAND D1608 (11-12-13) is blocked and flip-flop D1609 is set for normal switching by its clockpulse input signal. There is no longer a signal path for the alternate signal from the time-base generator to the vertical display logic other than via flip-flop D1609, NAND 1608 (8-9-10) and NAND D1607 (8-9-10).
The flip-flop output signal is also applied to R632 in the trace separation circuit to control the vertical space between the two time-base displays.

3.2.8. X Final amplifier

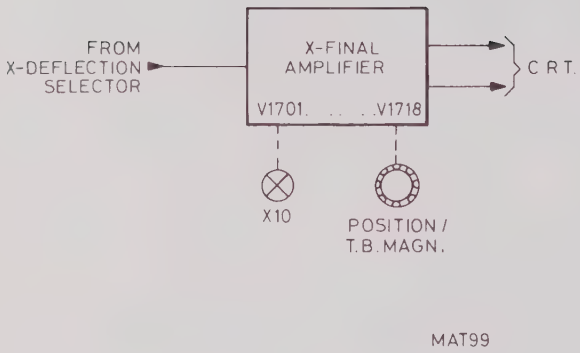


Fig. 3.14. X Final amplifier.

The final X amplifier consists of two identical amplifier stages in parallel (one for each deflection plate). One stage consists of transistors V1706, V1707, V1708 and V1709 and the other consists of transistors V1714, V1716, V1717 and V1718.

The final stage is supplied from the +60 V and −60 V because the X plates of the C.R.T. are mechanically displaced such that they are less sensitive than the Y plates.

The amplifier stages are controlled via the transistors V1701 and V1702.

With the X POSITION potentiometer R2 the bias of transistor V1702 can be varied.
Potentiometer R2 consists of a tandem potentiometer with back-lash, giving a nice vernier control. Variation of the bias causes the balance of the amplifier to be disturbed, which results in a horizontal trace shift on the screen.

The X amplifier allows choice from X deflection by the time-base signals or one of the sources, channel A, channel B, line or an external signal. The X deflection source is selected with the aid of X deflection mode selector switch S2 and the X deflection source selector switch S22.
The selected X deflection signal is applied via R1703 to the base of transistor V1701.

The X amplifier offers the possibility of using either the nominal gain (X1 position of X MAGN switch S3), or the gain increased by a factor of 10 (X10 position of the X MAGN switch S3).
When the front-panel X MAGN switch S3 is operated for X10 magnification, the emitter resistance of V1701 and V1702 is shunted by resistors R1704, R1706 and R1707 via relay K1701, reducing the value by a factor of 10. Consequently, the gain of the stage is increased by the same factor.

The X1 gain can be set by potentiometer R1709 and the gain X10 by potentiometer R1706. The gain X10 is not operative when EXT X DEFL is selected.

Both outputs of the X final amplifier are connected to the X deflection plates of the C.R.T.

For correct orthogonality adjustment a signal from the orthogonality potentiometer R1737 is applied to R661 in the final Y amplifier.

3.2.9. Cathode-ray tube circuit

The cathode-ray tube circuit comprises the C.R.T. itself and the brightness, focus, astigmatism, geometry and trace rotation controls and the beam blanking amplifier.
A block diagram of the C.R.T. circuit is given in fig. 3.15.

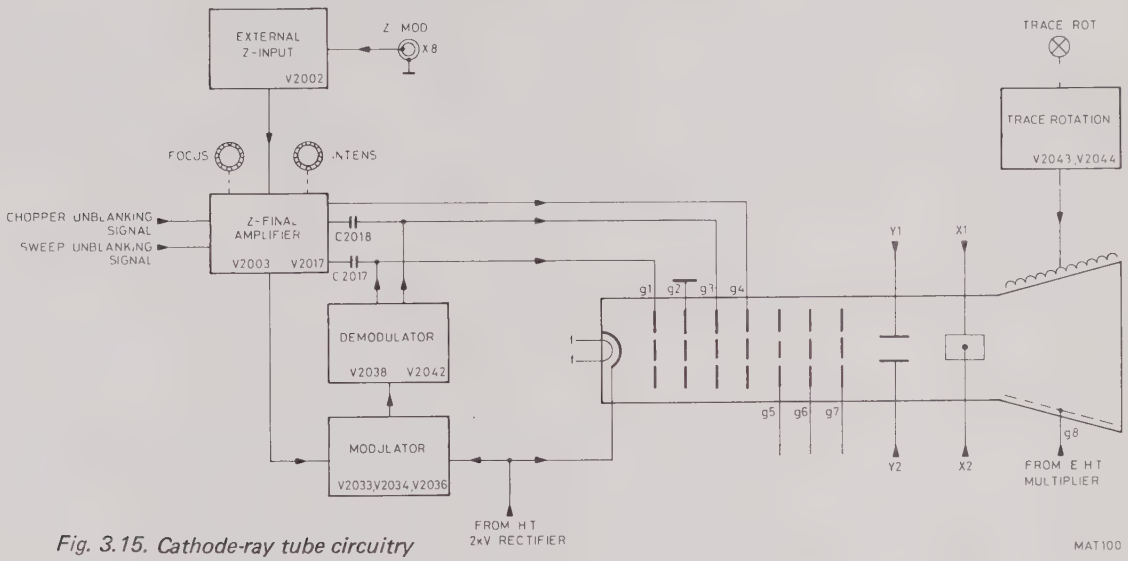


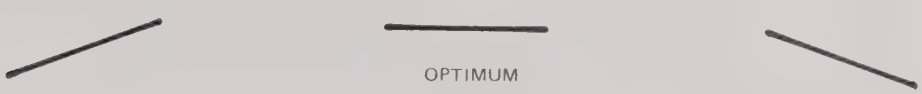
Fig. 3.15. Cathode-ray tube circuitry

3.2.9.1. C.R.T. controls

By means of the INTENS potentiometer R16, the brightness of the display can be continuously controlled. The display can be focused by means of the FOCUS potentiometer R17. Both INTENS and FOCUS controls are front panel controls.
Furthermore the C.R.T. circuitry comprises preset potentiometers for trace rotation, astigmatism and geometry.

The FOCUS control R17 forms a part of a voltage divider network across the 2 kV output of the power supply.

TRACE ROTATION is achieved by means of the trace rotation coil. This coil mounted inside the mu-metal screen, provides a magnetic field for rotational control of the entire scan. The degree and direction of rotation is determined by the setting of front panel potentiometer R15 (screwdriver operated). The slider of R15 is connected to the bases of the complementary transistors V2043 and V2044. The trace rotation coil is supplied by these transistors.



With the ASTIGMATISM control R2037, the form of the spot can be adjusted by influencing the voltage on grid G4.

With the GEOMETRY control R2039 the barrel and pin-cushion distortion is corrected by influencing the voltage on the grid G6.

OPTIMUM

3.2.9.2. Z unit and Focus unit

In these units, the controls for the following c.r.t. grids are located:

G1 Wehnelt cylinder controlled between −2200 V and −2300 V

G2 Screen grid at earth potential

G3 Focusing grid, at approximately −1000 V ... −1100 V

G4 Astigmatism grid at ± 30 V (adjustable from −60 V to +60 V).

Focus and modulation

To maintain a well-focused spot, independent of the beam current, the voltage pulse is applied to the focusing grid G3. This pulse is in antiphase with, and has an amplitude of approximately 60 % of the Z pulse on G1. The phase shift is achieved by differential stage V2006, V2011. This stage is followed by individual driver stages for G1 and G3.
The a.c. pulse is applied to grids G1 and G3 via capacitors C2017 and C2018 respectively.

The d.c. transfer is obtained by means of an oscillator, driven via R2064 and R2067, and a demodulator working at e.h.t. level. The oscillator pulses are transferred via C2038 and C2039 to be demodulated by diodes V2038 and V2039 (positive components) and by diodes V2041 and V2042 (negative components). The a.c. and d.c. paths of G3 are equalised by the voltage divider R2083, R2084.

Z-unit

The Z-amplifier has the following inputs:
– via the INTENS potentiometer R16.
– the external input socket X8 (Z-mod.).
– two signals originating in the main and delayed time-bases are applied to the amplifier to unblank the trace during the sweeps.
– the chopper blanking pulse to blank the trace during switching from channel to channel in the chopped mode.

The bright-up pulse of the main and delayed time-base is obtained in a similar way. In the main time-base, the pulse that switches V907 is also used for switching on and off transistor V903 and diode V904. Diode V904 is conductive when the time-base is running and in that case consumes about 3 mA from the switching unit. When V904 is blocked (during the hold-off time) a current (Z pulse) flows via V902 to R1542 in the Z-unit. This current is consumed by V904 when this diode is conductive.

The same conditions apply to the delayed time-base. When the position DEL'D TB is selected, transistor V1527 on the switching unit is turned off and resistor R1539 feeds 3 mA into the Z amplifier unit, which during the delayed time-base sweep is consumed via R1534 by V1307.
The sequence is as follows:
– start MTB, start DTB; less than 3 mA = half intensity.
– then start DTB; end of DTB; 0 mA = brilliance (bright-up pulse)
– then end DTB, end MTB; less than 3 mA = half intensity
– end MTB, start MTB; more than 3 mA = blanked pulse.

During the hold-off period, 3 mA is applied via V1528. The trace is then blanked regardless of any other control signals. This applies to the chopper blanking circuit, which supplies current pulses of 3 mA, via R1609. Resistor R2001 also supplies 3 mA, which can be bypassed by transistor V2003 as determined by the position of the INTENS potentiometer R16. This provides a continuous control of the trace brilliance. Finally, the external input pulse may take over the current of transistor V2003 via V2002, independent of the set brilliance. As a result of the current flowing through R2001, the c.r.t. is blanked. The sensitivity of the external Z input is adapted to suit TTL logic. Logic "1" provides blanking; logic "0" is ineffective.

3.2.9.3. CRT cathode regulation

To prevent sensitivity variations of the c.r.t., the cathode voltage is regulated. Variations of the a.c. supply voltage are applied via C2028 to an amplifier consisting of V2026, V2024 and V2023; d.c. variations are applied via R2051. The collector voltage of V2023 compensates for the voltage variations of the power supply and the rectifier. Consequently, the cathode voltage remains independent of the cathode current.

3.2.10 Power supply

The power supply comprises a mains transformer and rectifier, a DC to AC converter regulator and a transformer and output voltage rectifier

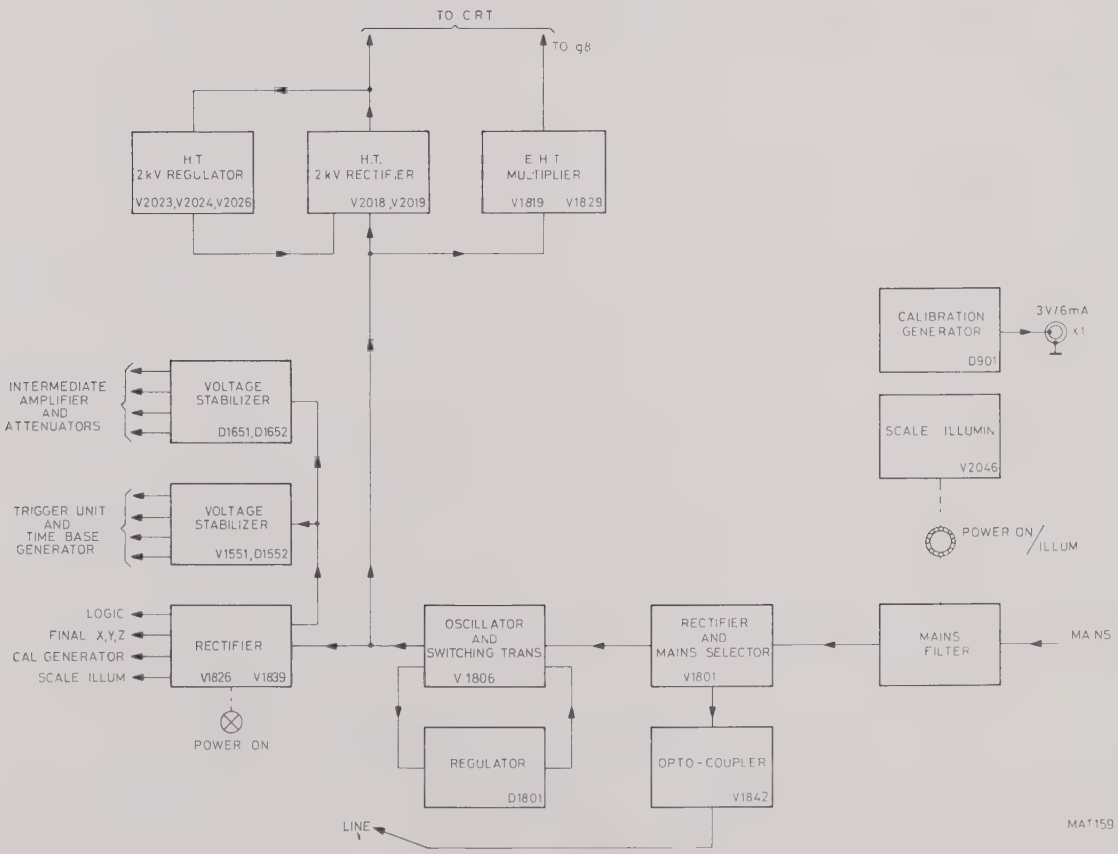


Fig. 3.16. Power supply

Input circuit

The power supply input circuit is matched to the 115 V or 230 V range with selector-switch S1801 which is located at the power supply unit at the rear side.
The mains voltage is rectified with the diode bridge V1801 and C1802, C1803, which form a voltage doubler in the 115 V position of S1801, and a standard bridge rectifier circuit in the 230 V position of S1801.
The voltage across the series circuit of C1802 and C1803 amounts 250 V to 400 V for both mains voltage ranges.

Switching circuit

The unregulated d.c. voltage is applied in the form of pulses to a resonance circuit consisting of the primary coil of the convertor transformer T1801, combined with C1807 and C1808, via switching transistor V1806.
The sine-wave voltage (approx. 800 Vp-p) across the primary coil of T1801 is kept constant by regulating the duty cycle of the base current of V1806.
The primary coil of L1806 which is in series with the switching transistor, limits the current through this transistor.
The energy stored in L1806 is fed-back to the mains rectifier circuit, during the cut-off time of V1806, via diode V1811.
V1808 and V1809 keep the dissipation during the switching moments out of transistor V1806; instead of these losses are dissipated in R1814 and R1816.
V1807 improves the base drive for V1806.

Regulator circuit

The regulator circuit itself consists of integrated circuit D1801 (type TDA 1060), the output (p.15) of which supplies a square wave current with variable duty-cycle to the base of V1812.
The duty-cycle of this signal is variable.
The collector signal of V1812 is applied to the switching transistor via transformer L1803.

The regulator circuit is controlled by:

- Feed-back voltage (p.3)
  This is the regulator control voltage and is taken from the rectifier circuit at the feed-back winding of T1801.
  This control voltage depends on the setting of R1826 (V out).
- Feed forward (p.16)
  This voltage is derived from the mains voltage and provides direct mains voltage variation compensation.
- Over-voltage protection (p.13)
  This voltage is also derived from the mains voltage and inhibits the regulator output at too high mains voltages (the trip-level on p.13 is 600 mV).
- Current limit (p.11)
  The voltage drop across the current-sense resistor R1811 controls the regulator circuit in case of overload.
- Frequency (p.7)
  The resistance between p.7 and gnd estimates the convertor frequency.
  R1827 (Freq.) has been adjusted to obtain a frequency of 20 kHz.
  The resonance frequency of C1807, 1808 and the primary coil of T1801 is wide enough to tolerate this.

Under normal working conditions the power supply voltages for the regulator circuit are delivered by the rectifier connected to the feed-back winding of T1801.
V1804 is then conducting so that V1803 does not deliver current.

Switching-on

When switching-on the instrument, no supply voltages are available in the regulator circuit, from T1801.
At this moment V1804 is not conducting, so that V1803 is fully conducting, and the regulator circuit gets current via R1804 and R1806.
As soon as the converter circuit is working V1804 becomes conducting and V1803 is not conducting anymore.

Switching-on protection

If the instrument is switched-on and no convertor voltage would appear (due to a possible defect) the PTC resistor R1806 will warm up, reducing the current through V1803 to a safe low value.

Output circuits

The output rectifiers are of the coil-input types delivering the mean value of the sine-wave transformer voltages across the output capacitor.
Except the d.c. voltages the convertor transformer delivers also:

- 6,3 V for the c.r.t heater
- 0-1 kV - 1,5 kV for the focus and high tension circuits
- 120 V for the additional power supply unit.

Photocoupler circuit

This circuit delivers a sine-wave voltage (derived from the mains voltage) used for mains triggering or mains deflection.
The photo-coupler V1842 which provides isolation between the mains voltage and the oscilloscope's circuitry drives the V1843-circuit in saturation, so that the square-wave voltage at the collector of V1843 has the same value for all mains voltages.
With an integration network R1851, 1852, 1853 and C1836, 1837, 1838 the original sine-wave is obtained.
Via V1844 and V1846 this signal is applied to the trigger selector (R730) via capacitor C1839.

3.2.11. Additional power supply

This unit delivers supply voltages for:

- the microprocessor circuit
- the event counter (partly +5,2 V)
- the LED display circuit.

120 Va.c. ($\approx$ 20 kHz) from the power supply unit is applied to the primary coil of transformer T1876.
The secundary rectifier circuits deliver +5 V and +6 V.
The +5,2 VS supply voltage for the event-counter ECL circuits is made by V1883 and D1876. The +5,2 V reference voltage for D1876 is taken from the time-base circuit.

3.2.12. Illumination circuit

The graticule of the C.R.T. can be illuminated by means of the bulbs E1 and E2. The intensity can be varied with the aid of ILLUM potentiometer R14 which controls the collector current (which is the current through the bulbs) of transistor V2046. The illumination circuit is not short-circuit proof.

3.2.13. Calibration circuit

The calibration unit is a square-wave generator consisting of an operational amplifier D1901 with feedback.
The oscillator frequency is determined by resistor R1909 and capacitor C1903. Capacitor C1902 keeps point 3 of the IC constantly equal to the average output voltage. Consequently, the generator is independent of fluctuations in the supply voltage.
The square-wave amplitude is determined by zenerdiode V1901.
Potentiometer R1906 allows accurate adjustment of the output voltage and output current.
This output voltage is fed to socket x1 and the output current flows through current loop x2. This is the front panel CAL terminal.
The calibrator output signal can be used for probe compensation and/or checking the vertical deflection accuracy.

3.3. DISMANTLING THE INSTRUMENT

3.3.1. General information

Warning: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.
If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved.
Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the oscilloscope should be adequately protected against damage, and all normal precautions regarding the use of tools must be observed. During dismantling procedures, a careful note must be made of all disconnected leads so that they may be reconnected to their correct terminals during assembly.

The E.H.T. cable is unbreakably connected to the c.r.t. (disconnection at E.H.T. voltage multiplier unit 15) When the E.H.T. cable to the post-acceleration anode of the c.r.t. is disconnected at the E.H.T. unit end, the E.H.T. cable must be discharged immediately by shortening them to earth.

Damage may result if the instrument is switched on when a circuit board has been removed, or if a circuit board is removed within one minute after switching off the instrument.

Note: For location of the various p.c. boards, see figures 3.29 and 3.30.

3.3.2. Removing the cabinet plates and the screen bezel

Both upper and lower cabinet plate can be removed after slackening one or two turns the four quick-release fasteners at the corners of each plate. Do not slacken the fasteners more than two turns, otherwise they may come apart.

The screen bezel can be detached by pressing the longer edges and pulling out.

3.3.3. Removing the knobs

Single knobs

- Prise off cap A
- Slacken screw (or nut) B
- Pull the knob from the spindle

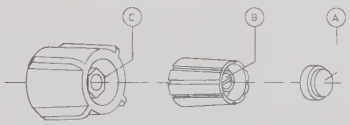


Fig. 3.17. Removing the knobs.

Double knob

- Prise off cap A and slacken screw B
- Pull the inner knob from the spindle
- Slacken nut C and pull the outer knob from the spindle

When fitting a knob or cap, ensure that the spindle is in a position which allows reference lines to be coincident with the markings on the text plate of the oscilloscope.

3.3.4. Removing the units

Next units can be easily removed after disconnecting the various wires and plugs and removing the appropriate mounting screws.

- Intermediate amplifier (unit 12)
- Delay line (unit 4)
- Focus unit (unit 7)
- Trigger amplifier (unit 9)
- Time-base unit (unit 8)
- Final-X amplifier (unit 26)
- Z-amplifier (unit 11)
- Additional power supply (unit 24)*

Remaining units can be removed as indicated in the following.

Input attenuator assembly (unit 2)

- Remove the cabinet top and bottom plates.
- Remove the shielding plate at the bottom side of the attenuator (remove 9 screws).
- Unplug the appropriate multipole connectors and coaxial cables.
- Remove the V/DIV attenuator knobs.
- Loosen the μP and event counter box (remove 5 screws).
  This unit need not being disconnected.
- Remove the two Allen-key screws, which clamp the attenuator at the bottom side to the frontpanel.
- Remove the two central nuts which clamp the attenuator to the frontpanel.
- The attenuator unit can be removed by shifting it backwards (carefully lifting away the μP and event counter box) and have it leaving the instrument via the bottom side.

Power supply unit (unit 5)

- Remove the lower cover plate.
- Remove the rear plate of the instrument (2 screws).
- Remove the black metal screening plate at the bottom side (6 screws).
- Remove the 2 screws which secure the unit to the rear panel.
- Remove the 3 screws which secure the unit to the bottom side of its compartment.
- Unplug the 5 multipole connectors from the unit.
- Disconnect the 2 pole connector to the Focus unit.
- Disconnect the white wire to the E.H.T. unit.
- Disconnect the 2 yellow wires from the transformer on the power supply unit.
- Carefully withdraw the unit out of its compartment.

Final Y amplifier (unit 13)

- Remove the upper cabinet plate.
- Remove the two screws which secure the bracket to the side strip.
- Disconnect the miniature coaxial plugs.
- Unplug the multipole connector.
- Remove the delay-line connections.
- Disconnect the wires from the C.R.T. pins and carefully lift out the circuit board.

E.H.T. unit (unit 15)

- Remove the lower cover plate.
- Remove the black metal screening plate at the bottom side (6 screws).
- Disconnect the E.H.T. cable by unscrewing the swivel nut and pulling the cable out of the E.H.T. unit.
- Carefully discharge the cable.
- Disconnect the white wire from the power supply unit.
- Disconnect the green wire from ground.
- To extract the E.H.T. unit, swivel out by applying slight pressure to one side of this unit.

*) *Danger*
The shielding of the c.r.t's e.h.t. cable is grounded via one of the mounting screws, of the additional power supply unit.

Do not switch on the instrument with this ground connection hanging loose !

Trigger source unit (unit 16)

- Remove the cabinet plates.
- Unplug the four multipole connectors.
- Remove the two Allen-key screws that secure the board to the front panel.
- Unscrew the two screws at the rear side of the board.
- Unsolder the wires at the components side of the board.
- Unplug the two miniature coaxial plugs at the soldering side of the board.
- Carefully lift the unit out of the oscilloscope.

Calibration unit (unit 17)

- Pull off the FOCUS and INTENS knobs.
- Remove the lower cabinet plate.
- Unplug the two multipole connectors.
- Disconnect the single wire connectors.
- Unsolder the two LED wires.
- Remove the two screw that secure the board to the front panel.
- Unscrew the screw which secure the board to the side strip.
- Carefully lift the unit out of the oscilloscope.

V.C.O. unit (unit 23)

- Remove the top cover plate.
- Remove the shielding plate of the V.C.O. unit (3 screws).
- Remove the 3 threaded spacers.
- Unsolder the 5 wires to the SET potentiometer assembly.
- Disconnect the flat cable from the Event-counter unit.
- Remove the unit.

LED display unit (unit 21)

- Remove the top cover plate.
- Disconnect the flat cable from the Event-counter unit.
- Remove the 2 mounting nuts.
- Remove the unit.

Microprocessor unit (unit 27)

- Remove the top cover plate.
- Remove the microprocessor unit-shielding plate (two screws).
- Disconnect the flat cable from the Event-counter unit .
- Disconnect D and ΔT wires from the trigger amplifier.
- Disconnect the CLK cable.
- Remove the four mounting screws.
- Remove the unit.

Event-counter unit (unit 28)

- Remove the top cover plate.
- Remove the microprocessor unit-shielding plate.
- Remove the two threated studs and carefully swing up the microprocessor and event-count assembly from the screening box.
- Disconnect the various cables (note the various connections for convenient reconnections later-on !).
- Remove the four mounting screws.
- Remove the unit.

3.3.5. Replacing a push-button switch

Each of the push-button sets is fitted to the front panel by means of two clamping devices secured by Allen-key screws, see Fig. 3.18.

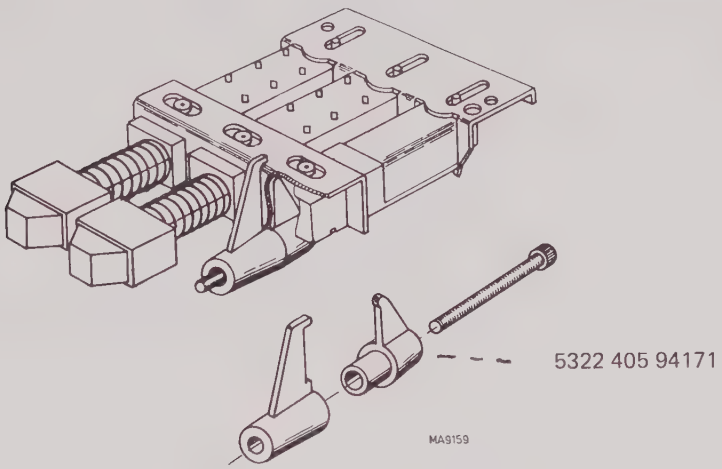


Fig. 3.18. Push-button set clamping device

To remove a push-button switch, the Allen-key screws that secure it to the front panel must be removed. To replace one switch-section of a push-button set, refer to Fig. 3.19.

To remove a push-button switch which is mounted on a p.c. board:

- Remove the printed-circuit board for replacing a switch in this unit
- Straighten the 4 retaining lugs of the relevant switch as shown in Fig. 3.19.
- Break the body of the relevant switch by means of a pair of pliers and remove the pieces. The soldering pins are then accessible.
- Remove the soldering pins and clean the holes in the printed-wiring board (e.g. with a suction soldering iron).
- Solder the new switch onto the printed-circuit board.
- Band the 4 retaining lugs back to their original positions.

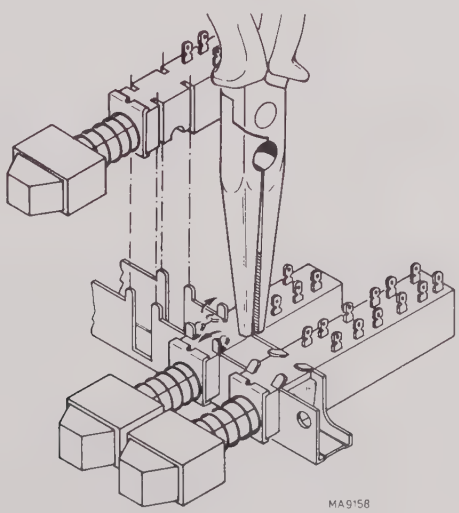


Fig. 3.19. Replacing a switch-segment of a push-button set

Note: Before a push-l tton switch is refitted to the front panel, it is advisable to stick the two parts of the clamping device together by means of adhesive tape or non-hardening glue, in order to facilitate replacement, refer to Fig. 3.18.

3.3.6. Removing the cathode-ray tube

Attention: Be very careful with the side connections of the c.r.t. If these pins are bent, the c.r.t. is likely to develop a gas leak.

- Remove the upper, lower and rear side instrument covers
- Remove the black coloured metal plate which is screening the focus and the Z-amplifier board
- Remove the bezel by pulling the lower edge
- Slacken the two screws that secure the upper scale illumination lamps support to the front panel
- Remove the tube base
- Slacken the brace round the c.r.t. neck
- Disconnect the E.H.T. cable after unscrewing the swivel nut and discharge the cable.
- Unsolder the screening wire of the E.H.T. cable
- Disconnect the TRACE ROT. wires
- Unplug the connectors on the c.r.t. neck
- Carefully withdraw the c.r.t. through the front panel of the instrument
- If the rubber sleeve around the neck of the c.r.t. must be slid over the neck of a replacement tube, the use of industrial talcum powder is strongly recommended, to prevent the rubber sleeve from sticking on the c.r.t. neck.

3.3.7. Removing the carrying handle

1. Remove the upper and lower cabinet plates
2. Remove the plastic strip which is snapped on to the grip
3. Remove the four screws which secure the grip to the brackets (these screws have been locked with a sealing varnisch).
4. Depress the push-buttons in the brackets and turn the carrying handle as far as possible to the upper side of the oscilloscope
5. Keep the push-button of the right-hand bracket depressed and pull the bracket from its bearing[1)]
6. Remove the grip from the remaining bracket
7. Depress the push-button of the left-hand bracket and turn the latter as far as possible to the lower side of the instrument.
8. Keep the push-button depressed and pull the bracket from its bearing.

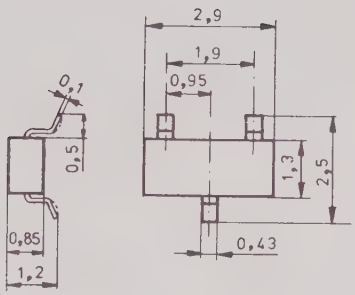
If it is impossible to remove the left-hand bracket in this way, remove also its bearing in a similar way as described in footnote 1).

---

1) With some instruments it may be impossible to remove the handle in the described way. This is due to an extra securing plate in the right-hand bearing. In that case, DO NOT USE FORCE, but work in accordance with the following procedure which replaces points 3, 4 and 5.

3. Remove the two screws which secure the grip to the right-hand bracket
4. Remove the two hexagonal bolts which secure the right-hand bearing to the side strip.
5. Depress the push-button of the right-hand bracket and take the bearing from the bracket.

3.3.8. Soldering micro-miniature semi-conductors



SOT-23

MA9154

Fig. 3.20. Dimensional drawing SOT-23

Because of the small dimensions of these SOT semi-conductors and the lack of space between the components on the printed-circuit board, it is necessary to use a miniature soldering iron with a pin-point tip (max. dia 1 mm) to solder a SOT on to a printed-circuit board.

Working method:

- Carefully unsolder one after the other the soldering tags of the semi-conductor
- Remove all superfluous soldering material. Use a sucking iron or sucking copper litze wire
- Check that the tags of the replacement part are clean and pre-tinned on the soldering places.
- Locate the replacement semi-conductor exactly on its place, and solder each tag to the relevant printed conductor on the circuit board.

NOTE: Bear in mind that the maximum permissible soldering time is 10 seconds during which the temperature of the tags must not exceed 250 deg C. The use of a solder with a low melting point is therefore recommended.

Take care not damage the plastic encapsulation of the SOT during the soldering procedure (softening point of the plastic is 150 ^{o}C).

ATTENTION: When you are soldering inside the instrument it is essential to use a low-voltage soldering iron, the tip of which must be earthed to the mass of the oscilloscope.

Suitable soldering irons are:

- ORYX micro-miniature soldering instrument, type 6A, voltage 6 V, in combination with PLATO pin-point tip type 0-569.
- ERSA miniature soldering iron, type minor 040 B, voltage 6 V.
- Low Voltage Mini Soldering Iron, Type 800/12 W - 6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1 mm-pin-point tip, order no. 4822 395 10012.

3.3.9. Special tools

Special tool for the slotted nut of attenuator switches A and B, order no. 5322 395 54023

For those who want to make such a tool, we give a sketch with the dimensions in mm in Fig. 3.21. The material is silversteel N094, tempered 40-45 Rc.

Special tool for the slotted nut of the POSITION and LEVEL/SLOPE potentiometers, order no. 5322 395 54024

For those who want to make such a tool, we give a sketch with the dimensions in mm in Fig. 3.22. The material is silversteel N094, tempered 40-45 Rc.

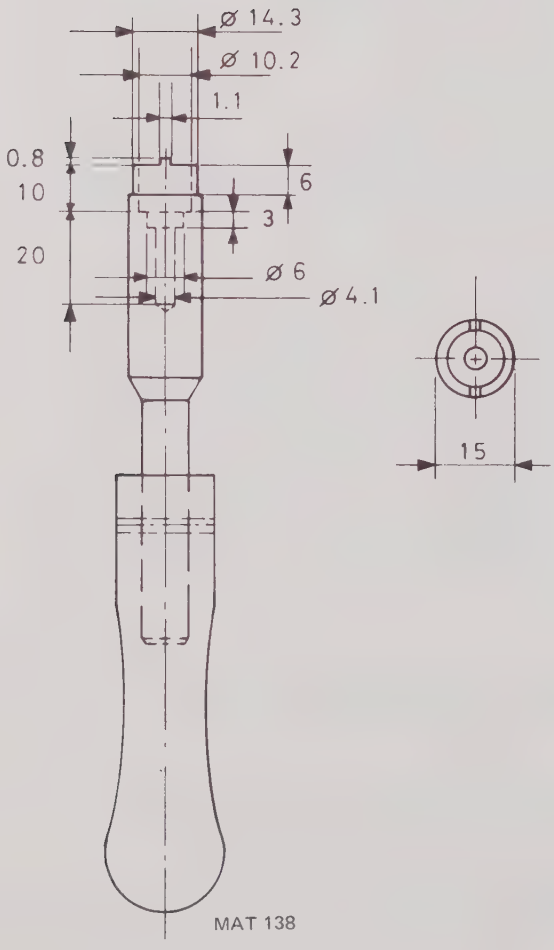


Fig. 3.21. Tool for attenuator unit

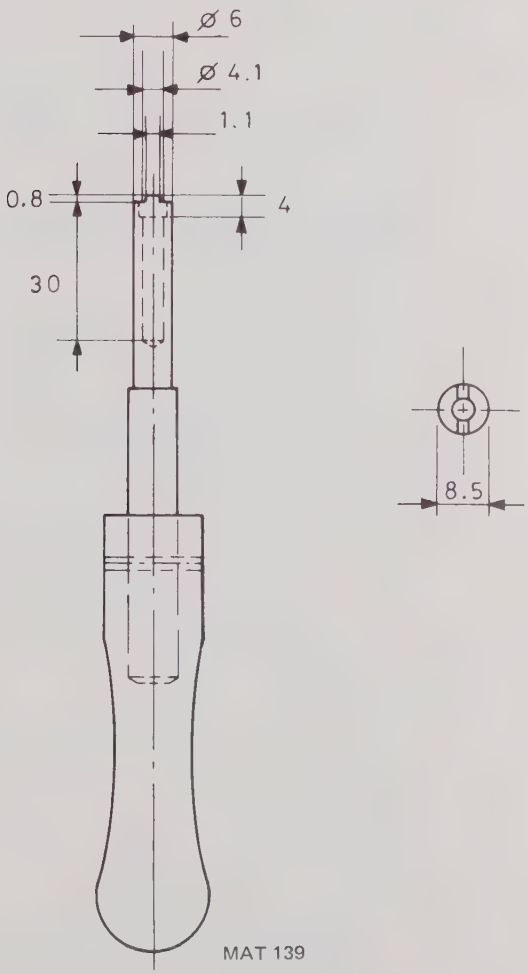


Fig. 3.22. Tool for positioning potentiometer

3.4. CHECKING AND ADJUSTING

3.4.1. General information

The following information provides the complete checking and adjusting procedure for the PM 3263 oscilloscope. As various control functions are interdependent, a certain order of adjustment is often necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature. Under average conditions this will be approximately 30 minutes after switching on.

All controls which are mentioned without item numbers are located on the front plate of the oscilloscope.

3.4.2. Recommended test equipment

Digital r.m.s. meter, e.g. PHILIPS PM 2527
Oscilloscope calibrator, e.g. TEKTRONIX TM503+SG503+TG501+PG506
2:1 dummy probe (Fig. 3.27.) e.g. TEKTRONIX type 067.0537.00
Oscilloscope with differential input facility, e.g. PHILIPS PM 3240
Low capacitance trimming tools.

3.4.3. Preliminary control settings

All preset potentiometers and trimming capacitors are indicated on the drawings of the printed-wiring board, see the figures 3.29. and 3.30.

- Push the Y POSITION controls to the NORM position
- Depress push-buttons DC of the signal-coupling controls
- Set push-buttons EV bef. MTB, EV bef. DTB, DELAY, Δ T and 1/T in released position.
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the TB MAGN control to position x1.
- Depress push-button AUTO of the trigger mode controls
- Set the MAIN TIME/DIV switch to 1 ms
- Set the DEL'D TIME/DIV switch to OFF
- Set all continuous controls to CAL
- Depress push-buttons DC of the trigger-coupling controls
- Depress push-buttons A of the trigger-source controls (S21, S22).

3.4.4. Power supply

3.4.4.1. Power consumption

- Check that the voltage has been set to the local mains voltage and connect the instrument to such a voltage
- Switch the oscilloscope on and check that the pilot lamp on the front panel lights up
- Check that the power consumption does not exceed 45 W (measured with a moving-iron meter)

3.4.4.2. +12,7 V supply voltage (unit 5)

- Check at nominal mains voltage that the voltage on the positive pole of C1831 is + 12,7 V ± 100 mV; if necessary, readjust potentiometer **R1826** on the power supply board
- Check that this voltage does not vary more than ± 50 mV when the mains voltage is varied between −10% + 20%

3.4.4.2.1. Pre-set potentiometer R 1827 (FREQ.)

This potentiometer is a factory adjustment control. THE SETTING OF THIS POTENTIOMETER MUST NOT BE DISTURBED UNLESS IT IS ABSOLUTELY IMPOSSIBLE TO SET THE 12,7 V WITH THE AID OF POTENTIOMETER R 1826

Adjusting procedure:

- Set the main input voltage to 220 V
- Turn potentiometer **R1827** fully anti-clockwise
- Check that the voltage on the positive pole of C1831 is 12,7 V ± 100 mV; if necessary; readjust potentiometer R1826 on the power supply board

- Set the mains input voltage to 170 V
- Check that the voltage on the positive pole of C1843 is +12,7 V ± 100 mV; if necessary, readjust potentiometer **R1826** on the power supply board.

3.4.4.3. Cathode voltage (unit 11)

- Check that the voltage on test point T4 (unit 11) on the **Z amplifier board** is 85 V ± 3 V
- If necessary, readjust potentiometer **R2048** on the Z amplifier board.

3.4.5. Calibration socket

If necessary, check the supply voltages first, refer to section (3.4.4.).

- Check the calibration square wave on irregularities
- Check that the amplitude of the CAL voltage is 3 V ± 1 %; if necessary, readjust potentiometer **R1906** on the calibration board
- Check that the frequency of the CAL voltage is 2 kHz, ± 2 %
- Check that the CAL current is 6 mA ± 1 %.

3.4.6. Cathode-ray tube circuit

3.4.6.1. Focus and astigmatism (unit 11)

- Check that the controls occupy the positions indicated in section 3.4.3.
- Depress push-button A of the display-mode controls (S1)
- Apply a sine-wave signal at a frequency of 100 kHz to input A
- Adjust the trace height to 6 DIV, using the AMPL switch and vernier
- Set the MAIN TIME/DIV switch and the LEVEL control to such a position that several complete cycles are displayed
- Set the INTENS potentiometer for normal brightness
- Check that an evenly sharp trace can be obtained with the aid of the FOCUS potentiometer. If necessary, readjust potentiometer **R2037** on the **Z amplifier unit**. After this adjustment, the FOCUS potentiometer must be approximately in mid-position. If necessary, this may be corrected by selecting a different value for resistor **R2074** on the Z amplifier unit
- Increase the trace brightness using the INTENS potentiometer
- Check that still a sharp trace may be obtained with the aid of the FOCUS potentiometer. If necesarry, optimize with the aid of **R2037**
- Remove the input signal.

3.4.6.2. Trace rotation

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X-deflection controls (S2)
- Centre the time-base line using the POSITION controls
- Check that the time-base line runs exactly in parallel with the horizontal graticule lines; if necessary, readjust the TRACE ROT control (R15) on the front panel.

3.4.6.3. Orthogonality (unit 8)

- Depress push-button ALT of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button 0 of the channel A signal-coupling controls
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TB switch to 5 μs
- Set the channel B AMPL switch to 5 mV/DIV and its vernier control to CAL
- Apply a sine-wave voltage of 120 mV, frequency 100 kHz, to input B
- Centre the intensified part of the trace, using the DELAY TIME control (R1)
- Centre the channel A time-base line, using the channel A POSITION potentiometer
- Check that the angle between the horizontal and vertical line is 90°, see Fig. 3.24. If necessary, readjust **R1737** on the **time-base board.**

3.4.6.4. Geometry (= barrel and pin cushion distortion) (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)

- Apply a sine-wave voltage at a frequency of approx. 100 kHz to input A
- Set the AMPL controls to obtain a trace height of 7,4 DIV
- Apply a sine-wave voltage at a frequency of approx. 50 Hz to input B
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Depress push-button B of the main time-base trigger-source controls (S22)
- Set the channel B AMPL switch and X AMPL control to obtain a display width of 9,4 DIV.
- Check that the edges of the display lie within the hatched area shown in Fig. 3.25; if necessary, readjust potentiometer **R2039** on the **time-base board**
- Remove the input signal.

3.4.6.5. Intensity (unit 11)

- Depress push-button A of the display-mode controls
- Depress push-button DEL'D TB of the X deflection controls
- Turn the INTENS potentiometer clockwise
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to 1 μs
- Depress push-button 0 of the signal-coupling controls
- Depress push-button MAIN TB of the delayed time-base trigger-source controls
- Check that there is a barely visible dot at the beginning of the trace. If necessary, readjust potentiometer **R2071** on the **Z amplifier board**

3.4.6.6. Intensity ratio (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Turn the DELAY TIME control (R1) to 5.0 (mid-position)
- Set the MAIN TIME/DIV switch to .2 ms and the DEL'D TIME/DIV switch to 50 μs
- Depress push-button AC of the channel A signal-coupling controls
- Apply a sine-wave signal at a frequency of 100 kHz to input A
- Set the display-height to 6 DIV
- Set the INTENS potentiometer to a position 90^{o} from the anti clockwise stop; see Fig. 3.26.
- Check that the trace of the main time-base generator is barely visible over the entire screen and that the part determined by the delayed time-base generator is more brilliant. If necessary, readjust potentiometer **R1537** on the **time-base board**

3.4.7. Balance adjustments

The adjustments of the vertical channels A and B are identical.
The knobs, sockets and adjusting elements of channel B are shown in brackets after those of channel A.
The balance adjustments influence one another and must, therefore, be readjusted in the order in which they are described.

3.4.7.1. 0-DC Balance (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Set the channel A (B) AMPL switch to 5 mV/DIV and the vernier control to CAL.
- Centre the time-base line, using the POSITION potentiometers
- Set the channel A (B) signal coupling switch from 0 to DC
- Check that the trace does not jump; if necessary, readjust potentiometer R124 (Ch. A) or R174 (Ch. B) on the **attenuator board.**

3.4.7.2. Attenuator balance (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Depress push-button 0 of the channel A (B) signal-coupling controls
- Centre the time-base line, using the POSITION controls
- Turn the AMPL switch between 5 V/DIV and 10 mV/DIV
- Check that the trace does not jump more than 0,1 DIV; if necessary, readjust potentiometer R129 (Ch. A) or R179 (Ch. B) on the **attenuator board.**

3.4.7.3. Continue balance (Unit 12)

- Depress push-button A (B) of the display-mode controls (S1)
- Depress push-button 0 of the channel A (B) signal-coupling controls
- Rotate the channel A (B) AMPL vernier control between minimum and maximum
- Check that the trace does not move more than 1 DIV in the 2 mV/DIV position, 0,4 DIV in the 5 mV/DIV position and 0,2 DIV in the other attenuator positions; if necessary, readjust potentiometer **R212 (R312)** on the **intermediate amplifier board.**

3.4.7.4. Balance 5 mV/div (unit 12)

- Depress push-button A (B) of the display-mode controls (S1)
- Depress push-button 0 of the channel A (B) signal-coupling controls
- Centre the time-base line, using the POSITION controls
- Check that the trace does not move more than 1 DIV when the AMPL switch is turned from 5 mV/DIV to 10 mV/DIV and not more than 0,1 DIV in the other positions except in the 2 mV/DIV position; if necessary readjust potentiometer **R222 (R322)** on the **intermediate amplifier board.**

3.4.7.5. Polarity (Norm/Invert) balance (unit 12)

- Depress push-button A (B) of the display-mode controls (S1)
- Depress push-button 0 of the channel A (B) signal-coupling controls
- Centre the time-base line, using the POSITION controls
- Set the channel A (B) AMPL switch to 10 mV/DIV
- Check that the time-base line does not shift more than 0,3 DIV when the channel A (B) POSITION control is pulled to INVERT; if necessary, readjust potentiometer **R259 (R359)** on the intermediate amplifier board.
- Set the channel A (B) AMPL switch to 2 mV/DIV
- Check that the time-base line does not shift more than 2 DIV, see also section 1.2.2.13., when the channel A (B) POSITION control is pulled to INVERT; if necessary, readjust potentiometer **R259 (R359)** on the **intermediate amplifier board.**

3.4.7.6. Trigger balance main time-base (unit 16, unit 12)

- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Depress push-button HF of the m.t.b. trigger-coupling controls (S20)
- Centre the time-base line using the m.t.b. LEVEL potentiometer
- Depress push-button DC of the m.t.b. trigger-coupling controls (S20)
- Check that the time-base line remains in the screen centre; if necessary, readjust potentiometer **R729** on the trigger source board
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Check that the time-base line remains in the screen centre; if necessary, readjust potentiometer **R426** on the **intermediate amplifier board**
- Depress push-button B of the m.t.b. trigger-source controls (S22)
- Check that the trace remains in the screen centre; if necessary, readjust potentiometer **R476** on the **intermediate amplifier board**
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave signal of 30 mV, frequency 2 kHz, to the m.t.b. EXT input
- Adjust the m.t.b. LEVEL potentiometer for a triggered display
- Check that the trace is written across the centre of the screen; if necessary, readjust potentiometer **R527** on the **intermediate amplifier board**
- Remove the input signal.

3.4.7.7. Trigger balance delayed time-base (unit 12)

- Depress push-button DEL'D TB of the X deflection controls (S2)
- Set the MAIN TIME/DIV switch to .5 μs and its vernier to CAL
- Set the DEL'D TIME/DIV switch to .2 μs and its vernier to CAL
- Depress push-button HF of the d.t.b. trigger-coupling controls
- Depress push-button A of the display-mode controls (S1)
- Set the channel A AMPL switch to 20 mV/DIV and its vernier to CAL
- Depress push-button A of the d.t.b. trigger-source controls (S21)

- Apply a sine-wave voltage of 120 mV, frequency 1 MHz, to input A
- Centre the display, using the channel A POSITION control
- Shift the starting point of the sine-wave to the central horizontal graticule line, using the d.t.b. LEVEL potentiometer.
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Check that the starting point of the sine-wave remains in the centre of the screen; if necessary, readjust potentiometer **R422** on the intermediate amplifier board.
- Depress push-button B of the display-mode controls (S1)
- Set the channel B AMPL switch to 20 mV/DIV and its vernier to CAL
- Depress push-button HF of the d.t.b. trigger-coupling controls
- Depress push-button B of the d.t.b. trigger-source controls (S21)
- Apply a sine-wave voltage of 120 mV, frequency 1 MHz, to input B
- Centre the display, using the channel B POSITION control
- Shift the starting point of the sine-wave to the central horizontal graticule line, using the d.t.b. LEVEL control.
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Check that the starting point of the sine-wave remains in the centre of the screen; if necessary, readjust potentiometer **R472** on the **intermediate amplifier board**
- Remove the input signal.

3.4.7.8. Y Position correction (unit 13)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Set the vertical POSITION potentiometer to mid-position
- Short-circuit the input of the delay line on the intermediate amplifier board
- Check that the time-base line is displayed exactly in the centre of the screen; if necessary, readjust potentiometer **R658** on the **final Y amplifier board.**

3.4.7.9. TB MAGN balance (unit 8)[1]

- Depress push-button MAIN TB of the X deflection controls (S2)
- Move the starting point of the time-base line to the centre of the screen, using the X POSITION control
- Check that the starting point does not move when the TB MAGN control is operated; if necessary, readjust potentiometer **R1749** on the **time-base board.**

3.4.8. Time-base generators

3.4.8.1. Main time-base time coefficients (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button AUTO of the trigger-mode controls (S8)
- Set the d.t.b. TIME/DIV switch to OFF and its vernier to CAL
- Depress push-button DC of the m.t.b. trigger-coupling controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Set the channel A AMPL switch to .1 V/DIV and its vernier to CAL
- Depress push-button DC of the channel A signal-coupling controls
- Apply a time-marker signal of 600 mV, pulse repetition rate 1 ms, to the channel A input
- Push the TB MAGN switch to x1
- Set the m.t.b. TIME/DIV switch to 1 ms and its vernier to CAL
- Check that the pilot lamps x10 and time-base UNCAL are off
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1709** on the time-base board
- Set the m.t.b. TIME/DIV switch to 5 ms
- Change the repetition rate of the input signal to 5 ms
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R913** on the time-base board
- Set the m.t.b. TIME/DIV switch to 1 μs
- Change the repetition rate of the input signal to 1 μs.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R911** on the time-base board.

- Pull the TB MAGN switch to x10
- Check that the x10 pilot lamp lights up
- Change the repetition rate of the input voltage to .1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1706** on the time-base board
- Push the TB MAGN switch to x1
- Set the m.t.b. TIME/DIV switch to .1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust trimmer capacitor **C916** on the time-base board
- Check that the other positions of the m.t.b. TIME/DIV switch, using the appropriate input signals; tolerance ± 2 % at an ambient temperature of 20 to +30 °C.
- Check that the control range of the m.t.b. TIME/DIV vernier control is 1:2,6 to 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of its CAL position.

3.4.8.2. Delayed time-base time coefficients (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button DEL'D TB of the X deflection controls (S2)
- Depress push-button AUTO of the trigger-mode controls (S8)
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Rotate the DELAY TIME control (R1) fully anti-clockwise (minimum delay time)
- Push the TB MAGN switch to x1
- Depress push-button A of the d.t.b. trigger-source controls (S21)
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to 1 ms and its vernier to CAL
- Check that the time-base UNCAL lamp is off
- Apply a time-marker signal of 600 mV, repetition rate 1 ms, to the channel A input
- Set the channel A AMPL switch to .1 V/DIV and its vernier to CAL
- Adjust the d.t.b. LEVEL control for a stationnary display
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1326** on the time-base board
- Set the m.t.b. TIME/DIV switch to 10 ms
- Set the d.t.b. TIME/DIV switch to 5 ms
- Change the repetition rate of the input signal to 5 ms
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1318** on the time-base board
- Set the m.t.b. TIME/DIV switch to 2 μs
- Set the d.t.b. TIME/DIV switch to 1 μs
- Change the repetition rate of the input signal to 1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1321** on the time-base board
- Set the m.t.b. TIME/DIV switch to .2 μs
- Set the d.t.b. TIME/DIV switch to .1 μs
- Change the repetition rate of the input signal to .1 μs
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust trimmer capacitor **C1311** on the time-base board
- Check the sweep times in all other positions of the d.t.b. TIME/DIV switch; tolerance ± 2% in temperature range +20 ... +30 °C. Keep during this check the DELAY TIME control fully anti-clockwise and the m.t.b. TIME/DIV switch one position slower than the d.t.b. TIME/DIV switch.
- Check that the control range of the d.t.b. TIME/DIV vernier control is 1:2,6 to 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of its CAL position.

3.4.8.3. V.C.O. adjusting (Unit 23). Refer to Fig. 3.23.

- Check that the mechanical click position of the SET potentiometer R1 is in the centre of the rotation angle (stop position).
- Check the voltage (UP/DOWN) on point 1 of D2301.

  UP : 0 V = logic 0
  DOWN: +5 V = logic 1

  The cross-over point (A) of this voltage must coincide with the click-position of the SET potentiometer R1. If necessary, the symmetry of the up and down ranges of the SET potentiometer R1 can be adjusted with potentiometer R2313 (SYMM.).
- Check the voltage on point 6 of D2302.
  This must be +5 V (logic 1) in the STOP position of SET potentiometer R1 and 0 V (logic 0) in the UP and DOWN ranges.
  The width of the STOP-range of SET potentiometer R1 is adjustable with potentiometer R2302 (GAP).

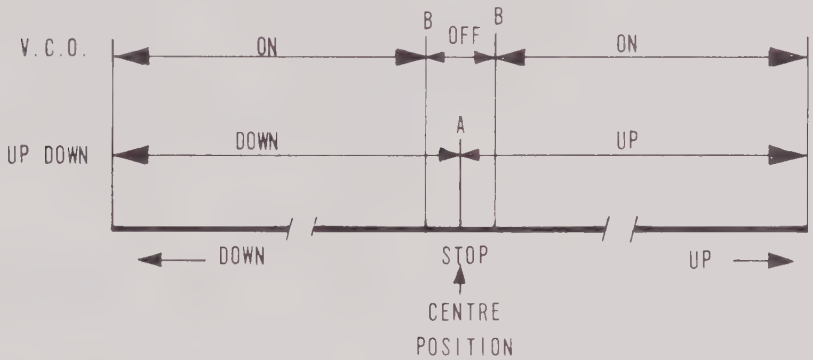


Fig. 3.23. Control range SET potentiometer R1.

A = cross-over point UP/DOWN
B = switching poins V.C.O. ON/OFF

- Check that the V.C.O. frequency is 1 Hz at the moment that the V.C.O. circuit is enabled (points B in Fig. 3.23.).
  If necessary, adjust potentiometer R2321 (FREQ.).
  The maximum V.C.O. frequency must be approximately 50 Hz.

Note that if switching to the FAST mode (SET knob pushed) the V.C.O. frequency is not changing. The FAST action is realised by the microprocessor which then counts in steps of 100 instead of steps of 1.

3.4.8.4. Dual DAC adjusting (unit 9)

- Depress push-button AUTO of the trigger mode controls.
- Depress push-button MTB of the X-deflection controls.
- Depress push-button MTB of the d.t.b. trigger source controls.
- Set the m.t.b. TIME/DIV switch to 1 ms/DIV and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to 10 µs/DIV and its vernier to CAL.
- Apply a time marker voltage with a repetition rate of 1 ms to the channel A input.

Note: For accurate comparison of the DELAY and ΔT markers, the DTB or ALT TB X-deflection mode may be selected.

- Depress push-button DELAY.
- Set the delay to 1.00 - 3. (shown on the LED display) with the SET potentiometer.
- Adjust R2602 in such a way that the DELAY marker starts at the beginning of the second division.
- Set the delay to 9.00 - 3.
- Adjust R2606 so, that the DELAY marker starts at the beginning of the 10th division.
- Set the delay to 1.00 - 3.
- Depress push-button ΔT.
- Set the ΔT value to zero with the SET potentiometer (see display).
- Adjust R2613 so, that the ΔT marker coincides with the DELAY marker.

- Release push-button ΔT.
- Set the delay to 9.00 - 3.
- Depress push-button ΔT (check that the ΔT time on the LED display is zero).
- Adjust R2626 so, that the ΔT marker coincides with the DELAY marker at the beginning of the 10th division.
- Release push-button ΔT.
- Set the delay to 1.00 - 3.
- Depress push-button ΔT.
- Set the ΔT to 8.00 - 3.
- Adjust R2617 so, that the ΔT marker starts at the beginning of the 9th division.

If necessary, repeat the whole procedure.

3.4.8.5. Alternate time-base and trace separation

- Depress push-button A of the display-mode controls (S1)
- Depress push-button ALT TB of the X deflection controls (S2)
- Set the m.t.b. TIME/DIV switch to .5 μs and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to .5 μs and its vernier to CAL
- Depress push-button 0 of the channel A signal-coupling controls
- Check that the distance between the two traces is 0 DIV with the TRACE SEP control turned anti-clockwise and approximately 4 DIV with this control turned clockwise.

3.4.9. Sensitivities

Before checking the sensitivities, check the balances in accordance with section 3.4.7. Balance adjustments.

3.4.9.1. Gain (sensitivity) Y_A VIA X

- Depress push-button B of the display-mode controls (S1)
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Depress push-button AC of the channel A signal-coupling controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel A AMPL switch to .5 V/DIV and its vernier to CAL
- Apply a 3 V square-wave voltage, frequency 2 kHz, to the channel A input.
- Check that the trace width is 6 DIV; if necessary, readjust GAIN potentiometer R12 on the front panel.

3.4.9.2. Gain (sensitivity) Y_A VIA Y (unit 13)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Depress push-button AC of the channel A signal-coupling controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel A AMPL switch to .5 V/DIV and its vernier to CAL
- Apply a 3 V square-wave voltage, frequency 2 kHz, to the channel A input.
- Check that the trace-height is 6 DIV; if necessary, readjust potentiometer **R654** on the **final Y amplifier board**
- Check that the control range of the channel A vernier control is 1:2,6 to 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of the CAL position

3.4.9.3. Gain (sensitivity) Y_B VIA Y

- Depress push-button B of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Depress push-button AC of the channel B signal-coupling controls
- Depress push-button B of the m.t.b. trigger-course controls
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel B AMPL switch to .5 V/DIV and its vernier to CAL

- Apply a 3 V square-wave voltage, frequency 2 kHz, to the channel B input
- Check that the trace height is 6 DIV; if necessary, readjust GAIN potentiometer R13 on the front panel
- Check that the control range of the channel B AMPL vernier control is 1:2,6 to 1:3,5 and the pilot lamp UNCAL lights up as soon as the vernier is out of the CAL position
- Remove the input signal

3.4.9.4. Gain (sensitivity) at external X deflection (unit 16)

- Depress push-button EXT $\overline{X}$ DEFL of the X deflection controls (S2)
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Set the X AMPL-HOLD OFF control to CAL
- Apply a 300 mV square-wave voltage, frequency 2 kHz, to the m.t.b. EXT input
- Check that the trace width is 6 DIV; if necessary, readjust potentiometer **R742** on the **trigger-source board**
- Check that the control range of the X AMPL-HOLD OFF control is 1:2,6 to 1:3,5
- Set the X AMPL-HOLD OFF control to CAL
- Depress push-button EXT ÷ 10 (S22) of the m.t.b. trigger-source controls
- Increase the amplitude of the input signal by a factor of 10
- Check that the trace width is 6 DIV ± 2 SUBDIV
- Remove the input signal

3.4.9.5. Gain (sensitivity) external triggering via TRIG VIEW (unit 9)

- Depress push-button TRIG VIEW of the display mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Apply a 600 mV square-wave voltage, frequency 2 kHz, to the m.t.b. EXT input
- Check that the trace height is 6 DIV; if necessary, readjust potentiometer R842 on the trigger-amplifier **board**
- Remove the input signal.

3.4.9.6. Gain (sensitivity) Y_A TRIG VIEW

- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Set the channel A AMPL switch to .5 V/DIV and its vernier to CAL
- Depress push-button A (S22) of the m.t.b. trigger-source controls
- Apply a 3 V square-wave voltage, frequency 2 kHz, to the channel A input
- Centre the display, using the m.t.b. LEVEL control R7
- Check that the trace height is 6 DIV ± 3 SUBDIV

3.4.9.7. Gain (sensitivity) Y_B TRIG VIEW

- Depress push-button TRIG VIEW of the display-mode controls (S1).
- Set the channel B AMPL switch to 0.5 V/DIV and its vernier to CAL
- Depress push-button B (S22) of the m.t.b. trigger-source controls.
- Apply a 3 V square-wave voltage, frequency 2 kHz, to the channel B input.
- Centre the display, using the m.t.b. LEVEL control R7.
- Check that the trace height is 6 DIV ± 3 SUBDIV

3.4.9.8. Gain (sensitivity) Y_B VIA X

- Depress push-button A of the display-mode controls (S1)
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Depress push-button AC of the channel B signal-coupling controls
- Depress push-button B S22 of the m.t.b. trigger-source controls
- Set the d.t.b. TIME/DIV switch to OFF
- Set the channel B AMPL switch to .5 V/DIV and its vernier to CAL
- Apply a 3 V square-wave voltage, frequency 2 kHz, to the channel B input
- Check that the trace width is 6 DIV ± 1 SUBDIV
- Remove the input signal.

3.4.10. Vertical channels

The adjustments of the vertical channels A and B are identical. The knobs, sockets and adjusting elements of channel B are shown in brackets after those of channel A. Before performing the following tests, the balances and sensitivities must be checked in accordance with sections 3.4.7. and 3.4.9.

3.4.10.1. L.F. correction amplifier (Attenuator unit)

- Depress push-button A (B) of the display mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Push the Y POSITION controls to position NORMAL
- Depress push-button DC of the channel A (B) signal-coupling controls
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Set the channel A (B) AMPL switch to 10 mV/DIV and its vernier to CAL
- Set the m.t.b. TIME/DIV switch to .2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage of 60 mV, repetition rate 200 Hz, to the channel A (B) input
- Check that the pulse top is straight; if necessary, readjust potentiometer R132 (ch. A) or R182 (ch. A) on **the attenuator board.**

3.4.10.2. Square-wave response (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Push the Y POSITION controls to NORMAL
- Depress push-button DC of the channel A (B) signal-coupling controls
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Set the m.t.b. TIME/DIV switch to .2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage with a frequency of 2 kHz, rise time $\leqslant$ 200 ns, to the channel A (B) input; peak to peak value as indicated in the table below
- Check that the pulse top errors do not exceed +/– 3%; if necessary, readjust the relevant trimmers

A (B) AMPL	Y_A (Y_B) input signal	Adjuster	Trace height
2 mV	12 mV	–	6 DIV +/–3 %
5 mV	30 mV	–	6 DIV +/–3 %
10 mV	60 mV	–	6 DIV +/–3 %
20 mV	120 mV	–	6 DIV +/–3 %
50 mV	300 mV	–	6 DIV +/–3 %
.1 V	600 mV	C107 (ch. A) or C157 (ch. B)	6 DIV +/–3 %
.2 V	1,2 V	–	6 DIV +/–3 %
.5 V	3 V	–	6 DIV +/–3 %
1 V	6 V	C112 (ch. A) or C162 (ch. B)	6 DIV +/–3 %
2 V	12 V	–	6 DIV +/–3 %
5 V	30 V	–	6 DIV +/–3 %

- Remove the input signal.

3.4.10.3. Input capacitance (Attenuator unit)

- Depress push-button A (B) of the display-mode controls (S1)
- Push the Y POSITION controls to NORMAL
- Depress push-button DC of the channel A (B) signal-coupling controls
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Set the m.t.b. TIME/DIV switch to .2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage with a frequency of 2 kHz, rise time $\leqslant$200 ns, to the channel A (B) input via an 2:1 dummy probe, Fig. 3.27.
  (1 Mohm ± 0,1 %//15 pF); peak to peak value as indicated in the table below
- Check that the pulse top errors do not exceed +/–3 %; if necessary, readjust the relevant trimmers.

A (B) AMPL	Y_A (Y_B) input signal	Adjuster	Trace height
2 mV	12 mV	C101 (ch. A) or C151 (ch. B)	3 DIV +/–3 %
5 mV	30 mV	–	3 DIV +/–3 %
10 mV	60 mV	–	3 DIV +/–3 %
20 mV	120 mV	–	3 DIV +/–3 %
50 mV	300 mV	–	3 DIV +/–3 %
100 mV	600 mV	C104 (ch. A) or C154 (ch. B)	3 DIV +/–3 %
.2 V	1,2 V	–	3 DIV +/–3 %
.5 V	3 V	–	3 DIV +/–3 %
1 V	6 V	C109 (ch. A) or C159 (ch. B)	3 DIV +/–3 %
2 V	12 V	–	3 DIV +/–3 %
5 V	30 V	–	3 DIV +/–3 %

– Remove the input signal.

Square-wave response final Y amplifier

– Depress push-button ALT of the display-mode controls (S1)
– Depress push-buttons A and B (COMP) of the m.t.b. trigger-source controls (S22)
– Depress push-button MTB of the X deflection controls (S2)
– Set the Y POSITION controls to obtain a distance of 6 DIV between both time-base lines (channel A time-base line at the top)
– Set the X Magnifier in the x1 position
– Remove the main time-base connector from the alternate control pulse socket on the intermediate amplifier board, unit 12, socket 9, Fig. 3.29.
– Connect a square-wave generator to socket 9, Fig. 3.29.
– Set the output voltage of the generator to 3 V
– Both time-base lines will be displayed at a frequency determined by the frequency of the square-wave voltage.

200 Hz (unit 13)

– Set the generator frequency to 200 Hz
– Set the m.t.b. controls to obtain a suitable, triggered display
– Check that the top of the displayed pulse in straight within 2%; if necessary, put R634 in its mid position and select C613 to such a value that the square wave response is optimal.
– Adjust R634 to optimal square wave response.

2 kHz (unit 13)

– Set the generator frequency to 2 kHz
– Set the m.t.b. controls to obtain a suitable, triggered display
– Check that the top of the displayed pulse is straight within 2%; if necessary, put R636 in its mid position and select C614 to such a value that the square wave response is optimal.
– Adjust R636 to optimal square wave response.
– Reconnect socket 9 (Fig. 3.29.).

Square-wave response channel A (unit 12)

– Depress push-button A of the display-mode controls (S1)
– Push the Y POSITION controls to the NORM position
– Depress push-button DC of the channel A signal-coupling controls
– Set the channel A AMPL switch to 10 mV/DIV and its vernier to CAL
– Set the XMagnifier in the X1 position
– Depress push-button MTB of the Xdeflection controls (S2)
– Depress push-button A of the m.t.b. trigger-source controls (S22)
– Set the m.t.b. TIME/DIV switch to a suitable value
– Set the d.t.b. TIME/DIV switch to OFF
– Apply a square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2 kHz, to the channel A input
– Determine (for example with the use of an auxiliary potentiometer) the value for R256 that gives the best square wave response. A resistor with the selected value (between 1k6 and 4k7) must be soldered on the unit.
– Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary readjust potentiometer R255A or select a different value for capacitor C224 on the intermediate Y amplifier adjusting board
– Increase the repetition rate of the input signal to 30 kHz
– Put the instrument in the Magnifier X10 mode for better waveform analysis

- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, readjust potentiometers R253A and R254A or select a different value for capacitors C222 and C223 on the intermediate Y amplifier adjusting board
- Increase the repetition rate of the input signal to 100 kHz
- Check that the pulse is straight within 2% and that the rise time is as short as possible, if necessary, readjust trimmers C221 on the intermediate Y amplifier board
- Select C200 on the intermediate amplifier (unit 12) to such a value (between 3p3 and 6p8) that the square wave response is optimal
- Set the generator frequency to 30 kHz
- Set the m.t.b. controls to obtain a suitable, triggered display
- Check that the top of the displayed pulse is straight within 2%; if necessary , readjust trimmer C616 on the final Y amplifier board
- Set the generator frequency to 100 kHz
- Set the m.t.b. controls to obtain a suitable, triggered display
- Check that the top of the displayed pulse is straight within 2%; if necessary, select a different value for resistor R646 on the final Y amplifier board
- Check the square-wave response in positions 5 mV/DIV and 2 mV/DIV of the AMPL switch at input voltages of 30 mV and 12 mV. The pulse top aberrations must not exceed 2%
- Pull the channel A Y POSITION control to INVERT
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within 2%
- Depress push-button O of the channel A signal-coupling controls
- Depress push-button ADD of the display-mode controls and check that the response does not change
- Check that the pulse top aberrations remain within ±2%
- Remove the input signal

3.4.10.6. Square-wave response channel B (unit 12)

- Depress push-button B of the display-mode controls (S1)
- Push the channel A POSITION control to NORM position
- Depress push-button DC of the channel B signal-coupling controls
- Set the channel B AMPL switch to 10 m V/DIV and its vernier to CAL
- Set the XMagnifier in the X1 position
- Depress push-button MTB of the X deflection controls (S2)
- Depress push-button B of the m.t.b. trigger source-controls (22)
- Set the m.t.b. TIME/DIV switch to a suitable value
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2 kHz, to channel B input
- Determine (for example with the use of an auxililiary potentiometer) the value for R356 that gives the best square wave response. A resistor with the selected value (between 1k6 and 4k7) must be soldered on the unit
- Check that the pulse top is straight within 2% and the rise time is as short as possible; if necessary readjust potentiometer R255B or select a different value for capacitor C324 on the intermediate Y amplifier adjusting board
- Increase the repetition rate of the input signal to 30 kHz
- Put the instrument in the Magn X10 mode for better waveform analysis
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, readjust potentiometers R253B and R254B or select a different value for capacitors C322 and C323 on the intermediate Y amplifier adjusting board
- Increase the repetition rate of the input signal to 100 kHz
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, readjust trimmers C321 (this one also affects channel A) on the intermediate amplifier board
- Select C300 on the intermediate amplifier (unit 12) to such a value (between 3p3 and 6p8) that the square wave response is optimal
- Check the square-wave response in position 5 mV/DIV and 2 mV/DIV of the AMPL switch at input voltages of 30 mV and 12 mV. The pulse top aberrations must not exceed 2%
- Pull the channel B POSITION control to INVERT
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within 2%
- Depress push-button O of the channel B input-coupling controls
- Depress push-button ADD of the display-mode and check that the response does not change
- Check that the pulse top aberrations remain within ± 2%
- Remove the input signal

3.4.10.7. Bandwidth

- Depress push-button A (B) of the display-mode controls (S1)
- Push the Y POSITION controls to the NORM position
- Set the channel A (B) AMPL switch to 2 mV/DIV and its vernier to CAL
- Depress push-buttons AC of the signal coupling controls
- Depress push-button MTB of the X deflection controls (S2)
- Push the TB MAGN switch to x1
- Depress push-button AUT of the trigger-mode controls
- Depress push-button HF of the trigger-coupling controls
- Depress push-button A (B) of the trigger-source controls (S22)
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a sine-wave voltage of 16 mV_{p-p}, frequency 2 MHz , to the channel A (B) input
- Check that the trace height is 8 DIV
- Increase the frequency of the input signal to 35 MHz
- Check that the trace height is at least 5,6 DIV
- Set the channel A (B) AMPL switch to 5 mV/DIV and its vernier to CAL
- Increase the input voltage to 40 mV_{p-p}, frequency 2 MHz
- Check that the trace height is 8 DIV
- Increase the frequency of the input voltage to 100 MHz
- Check that the trace height is at least 5,6 DIV
- Remove the input signal

3.4.10.8. Common-mode rejection

- Depress push-button ADD of the display-mode controls (S1)
- Push the channel A POSITION control to NORM
- Push the channel B POSITION control to INVERT
- Set both AMPL controls to 10 mV/DIV and their verniers to CAL
- Apply a sine-wave voltage of 240 mV_{p-p} simultaneously to the channel A and B inputs
- Check the rejection in accordance with the following table

Note: Adjust the channel A or B AMPL vernier control for minimum trace height.

Input voltage	Frequency	Max. trace height	Rejection factor
240 mV	100 kHz	1,2 SUBDIV	>100
240 mV	2 MHz	1,2 SUBDIV	> 100
240 mV	50 MHz	6 SUBDIV	> 20

- Remove the input signal.

3.4.10.9. Dynamic range and position range

- Depress push-button A of the display-mode controls (S1)
- Set both AMPL switches to 5 mV/DIV and their verniers to CAL
- Apply a sine-wave signal of 120 mV_{p-p}, frequency 10 kHz, to the channel A (B) input
- Check that the top and bottom parts of the sine-wave signal can be displayed, reasonably undistorted, within the measuring graticule, using the channel A (B) POSITON control
- Remove the input signal.

3.4.10.10. Chopped mode

- Depress push-button CHOP of the display-mode controls
- Set the m.t.b. TIME/DIV switch to .2 μs
- Check that there are two time-base lines displayed which can be shifted in relation to each other, using the Y POSITON controls.

3.4.10.11. Alternate mode

- Depress push-button ALT of the display-mode controls
- Set the m.t.b. TIME/DIV switch to 10 μs
- Check that there are two time-base lines displayed which can be shifted in relation to each other, using the Y POSITION controls
- Set the m.t.b. TIME/DIV switch to .1 s
- Check that the channels are switched over after every sweep of the time-base voltage.

3.4.10.12. Square-wave response trigger view via channel A (B) (Unit 12)

- Depress push-button TRIG VIEW of the display-mode controls
- Push the Y POSITION controls to the NORM position
- Depress push-button DC of the channel A and B signal-coupling controls
- Set both AMPL switches to 10 mV/DIV and their verniers to CAL
- Depress push-button MTB of the X deflection controls
- Depress push-button A (B) of the m.t.b. trigger-source controls
- Set the m.t.b. TIME/DIV switch to a suitable position
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a square-wave voltage of 60 mV, frequency 2 kHz, rise time 1 ns, to the channel A (B) input
- Check that the pulse top is straight and the rise time as short as possible
- Increase the repetition rate of the input signal to 30 kHz
- Check that the pulse top is straight within 5 % and that the rise time is as short as possible, if necessary, select a different value for resistors **R255D, R254D (R255C, R254C)** and capacitors **C400, C405 (C450 C455)** on the intermediate amplifier board
- Increase the repetition rate of the input signal to 100 kHz
- Check that the pulse top is straight within 5 % and that the rise time is as short as possible; if necessary, select a different value for resistor **R253D (R253C)** and capacitors **C410 (C460)** on the **intermediate amplifier board**
- Remove the input signal.

3.4.10.13. Bandwidth trigger view via channel A (B)

- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Push the Y POSITION controls to NORM position
- Set both AMPL switches to 10 mV/DIV and their verniers to CAL
- Depress push-buttons AC of the signal-coupling controls
- Depress push-button MTB of the X deflection controls (S2)
- Push the TB MAGN switch to x1
- Depress push-button AUTO of the trigger-mode controls
- Depress push-button HF of the m.t.b. trigger-coupling controls
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a sine-wave voltage of 60 $mV_{p\text{-}p}$, frequency 2 MHz, to the channel A (B) input
- Check that the trace height is 6 DIV
- Increase the frequency of the input voltage to 50 MHz
- Check that the trace height is at least 4,2 DIV
- Remove the input signal

3.4.10.14. Bandwidth trigger view via external input

- Depress push-button TRIG VIEW of the display-mode controls (S1)
- Depress push-button MTB of the X deflection controls (S2)
- Depress push-button EXT of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave voltage of 600 $mV_{p\text{-}p}$, frequency 2 MHz, to the m.t.b. EXT input
- Check that the trace height is 6 DIV
- Increase the frequency of the input signal to 50 MHz
- Check that the trace height is at least 4,2 DIV
- Remove the input signal.

3.4.11. Triggering

3.4.11.1. Trigger slope and level of the m.t.b. (unit 8)

- Depress push-button A of the display-mode controls (S1)
- Depress push-button MTB of the X deflection controls (S2)
- Depress push-button DC of the m.t.b. trigger-coupling controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Depress push-button DC of the channel A input-coupling controls
- Push the channel A Y POSITION control to the NORM position
- Set the channel A AMPL switch to 20 mV and its vernier to CAL
- Set the m.t.b. TIME/DIV switch to 10 μs and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Apply a sine-wave voltage of 120 mV_{p-p}, frequency 30 kHz, to the channel A input
- Centre the display, using the POSITION controls
- Centre the starting point of the sine-wave, using the m.t.b. LEVEL control
- Check that the starting point of the signal does not move when the SLOPE switch is set from + to –; if necessary, readjust potentiometer **R881** on the **trigger-amplifier board**
- Push the SLOPE switch to its + position
- Check that the time-base generator starts on the positive-going edge of the sine-wave and moves upwards when the LEVEL potentiometer is turned clockwise
- Pull the SLOPE switch to its – position
- Check that the time-base generator starts on the negative-going edge of the sine-wave.
- Set the channel A AMPL switch to 5 mV/DIV
- Rotate the m.t.b. LEVEL control fully clockwise and fully anti-clockwise
- Check that in both extreme positions the time-base generator cuts out and that the NOT TRIG'D lamp lights up
- Increase the amplitude of the input signal to 160 mV_{p-p}
- Rotate the m.t.b. LEVEL control fully clockwise and anti-clockwise
- Check that in both extreme positions the trace remains triggered and that the NOT TRIG'D lamp does not light up
- Depress push-button TTL of the m.t.b. trigger mode switch
- Set the channel A AMPL/DIV switch to 1V and its vernier to CAL
- Apply a square-wave voltage of 2V p-p, which is superponised on a variable DC voltage, to the channel A input socket. (Use for example a PHILIPS PM 5167 function generator).
- A square-wave signal with a trace height of 2 division will now be visible on the screen
- Set the m.t.b. TIME/DIV switch to such a position that a reasonable number of sine-waves is written on the screen
- Set the DC offset knob of the function generator so that the lower level of the square-wave voltage on the screen is shifted to +0,8 division from 0 level
- Adjust R 860 so that the signal is just triggered
- Remove the input signal.

3.4.11.2. Trigger sensitivities m.t.b.

- Depress push-button MTB of the X deflection controls (S2)
- Adjust the m.t.b. LEVEL control for a stationary display
- Depress push-buttons DC of the signal-coupling controls
- Set the m.t.b. TIME/DIV switch to such a position that a reasonable number of sine waves is written on the screen
- Set the d.t.b. TIME/DIV switch to OFF
- Check the trigger sensitivity in accordance with the table below

Input	Frequency sine wave	Display mode	Trigger mode	Trigger coupling	Trigger source	Trace height/ Volts
A	20 Hz	A	AUTO	DC	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	AUTO	DC	A	1 DIV up to 1,5 DIV
A	20 Hz	A	TRIG	DC	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	TRIG	DC	A	1 DIV up to 1,5 DIV
A	20 kHz	A	TRIG	LF	A	0,5 DIV up to 1,5 DIV
A	20 kHz	A	TRIG	HF	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	TRIG	HF	A	1 DIV up to 1,5 DIV
B	20 Hz	B	TRIG	DC	B	0,5 DIV up to 1,5 DIV
B	20 kHz	B	TRIG	DC	B	0,5 DIV up to 1,5 DIV
B	100 MHz	B	TRIG	DC	B	1 DIV up to 1,5 DIV
EXT	20 Hz	A	TRIG	DC	EXT	50 mV up to 150 mV
EXT	20 kHz	A	TRIG	DC	EXT	50 mV up to 150 mV
EXT	100 MHz	A	TRIG	DC	EXT	50 mV up to 150 mV
A and B	20 kHz	ALT	TRIG	DC	A+B	

– Remove the input signal

3.4.11.3. Single-sweep operation

– Depress push-button A of the display-mode controls (S1)
– Set the channel A AMPL switch to .2 V/DIV and its vernier to CAL
– Depress push-button MTB of the X deflection controls (S2)
– Set the m.t.b. LEVEL control to mid-range
– Set the m.t.b. TIME/DIV switch to .1 s and the vernier to CAL
– Set the d.t.b. TIME/DIV switch to OFF
– Depress push-button A of the m.t.b. trigger-source controls (S22)
– Depress push-button 0 of the channel A signal-coupling controls
– Apply a signal that gives a trace height of approx. 6 DIV to input A
– Push the SINGLE button of the m.t.b. trigger-mode controls
– Check that the NOT TRIG'D lamp lights up
– Depress push-button AC of the channel A signal-coupling controls
– Check that the trace is written once and that the NOT TRIG'D lamp is extinghuished at the end of the sweep
– Remove the input signal.

3.4.11.4. Triggering at mains frequency

– Depress push-button A of the display-mode controls (S1)
– Depress push-button MTB of the X deflection controls (S2)
– Depress push-button AUTO of the trigger-mode controls
– Depress push-button DC of the trigger-coupling controls
– Set the m.t.b. TIME/DIV switch to 5 ms and its vernier to CAL
– Depress push-button EXT of the trigger-source controls (S22)
– Apply a mains voltage derived signal to the channel A input
– Adjust the trace height to approx. 3 DIV; the trace must be running
– Depress push-button EXT and EXT ÷ 10 (S22) simultaneously (LINE)
– Check that a stable display can be obtained, using the m.t.b. LEVEL control
– Remove the input signal.

3.4.11.5. Trigger slope and level of the d.t.b.

- Depress push-button A of the display-mode controls (S1)
- Depress push-button DEL'D TB of the X deflection controls (S2)
- Depress push-button A of the d.t.b. trigger-source controls (S21)
- Depress push-button DC of the d.t.b. trigger-coupling controls
- Push the channel A Y POSITION control to the NORM position
- Set the channel A AMPL switch to 20 mV/DIV and its vernier to CAL
- Depress push-button DELAY
- Set the delay to zero with potentiometer SET.
- Set the m.t.b. TIME/DIV switch to 20 μs and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to 10 μs and its vernier to CAL
- Apply a sine-wave voltage of 120 mV_{p-p}, frequency 30 kHz, to the channel A input
- Centre the display, using the POSITION controls
- Centre the starting point of the sine-wave, using the d.t.b. LEVEL control
- Check that the starting point of the signal does not move when the SLOPE switch is set from + to –
- Push the SLOPE switch to its + position
- Check that the time-base generator starts on the positive-going part of the sine-wave and moves upwards when the d.t.b. LEVEL potentiometer is turned clockwise
- Pull the SLOPE switch to – position
- Check that the time-base generator starts on the negative-going part of the sine-wave
- Set the channel A AMPL switch to 5 mV/DIV and its vernier to CAL
- Rotate the d.t.b. LEVEL control fully clockwise and anti-clockwise
- Check that in both extreme positions the time-base generator cuts out
- Increase the amplitude of the input signal to 160 mV_{p-p}
- Rotate the d.t.b. LEVEL control fully clockwise and anti-clockwise
- Check that in both extreme positions the trace remains triggered.
- Depress push-button TTL of the d.t.b. trigger mode switch
- Set the channel A AMPL/DIV switch to 1V and its vernier to CAL
- Apply a square-wave voltage of 2V p-p, which is superponised on a variable DC voltage, to the channel A input socket (Use for example a PHILIPS PM 5167 function generator)
- A square-wave signal with a trace height of 2 divisions will now be visible on the screen
- Set the d.t.b. TIME/DIV switch to such a position that a reasonable number of sine-waves is written on the screen
- Set the DC offset knob of the function generator so that the lower level of thesquare-wave voltage on the screen is shifted to +0,8 division from the 0 level
- Adjust R 1260 so that the signal is just triggered
- Remove the input signal

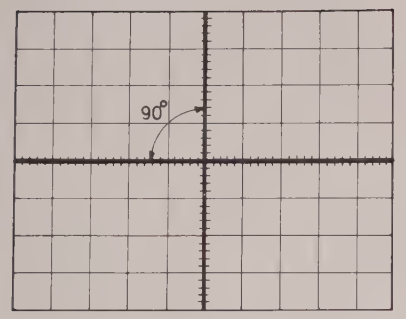


Fig. 3.24. Orthogonality check

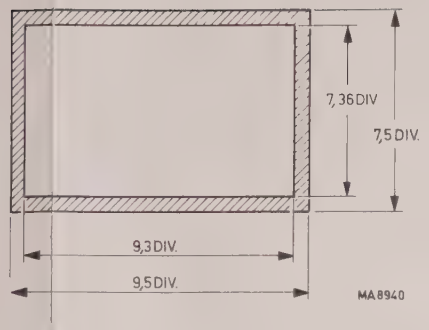


Fig. 3.25. Geometry check

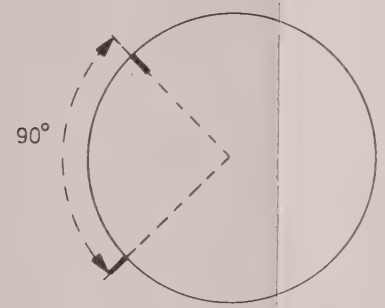


Fig. 3.26. Position of the INTENS potentiometer

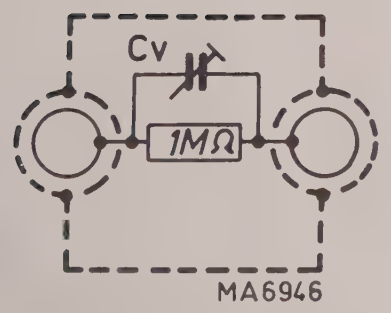


Fig. 3.27. 2:1 Dummy probe

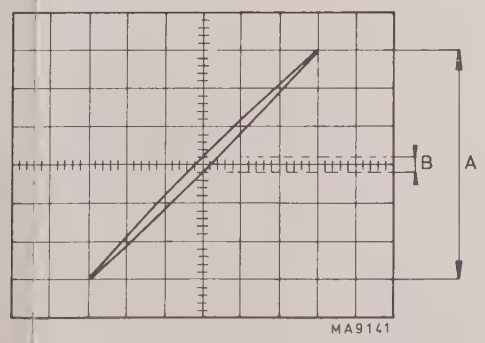


Fig. 3.28. Phase difference in X-Y mode

3.4.11.6. Trigger sensitivities d.t.b.

- Depress push-button DEL'D TB of the X deflection controls (S2)
- Adjust the d.t.b. LEVEL control for a stationary display
- Depress push-button AUTO of the m.t.b. trigger-mode controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Depress push-buttons DC of the signal-coupling controls of the m.t.b.
- Set the m.t.b. TIME/DIV switch one position lower (longer sweep time) than the d.t.b. TIME/DIV switch
- Set the d.t.b. TIME/DIV switch to such a position that a reasonable number of sine waves is written (not for 20 Hz)
- Check the trigger sensitivity in accordance with the table below

Input	Frequency sine wave	Display mode	Trigger coupling d.t.b.	Trigger source d.t.b.	Trace height Volts
A	20 Hz	A	DC	MAIN TB	0,5 DIV up to 1,5 DIV
A	100 MHz	A	DC	MAIN TB	1 DIV up to 1,5 DIV
A	20 Hz	A	DC	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	DC	A	1 DIV up to 1,5 DIV
A	20 Hz	A	LF	A	0,5 DIV up to 1,5 DIV
A	20 kHz	A	LF	A	0,5 DIV up to 1,5 DIV
A	20 kHz	A	HF	A	0,5 DIV up to 1,5 DIV
A	100 MHz	A	HF	A	1 DIV up to 1,5 DIV
B	20 Hz	B	DC	B	0,5 DIV up to 1,5 DIV
B	20 kHz	B	DC	B	0,5 DIV up to 1,5 DIV
B	100 MHz	B	DC	B	1 DIV up to 1,5 DIV
EXT dtb	20 Hz	B	DC	EXT	50 mV up to 150 mV
EXT dtb	20 kHz	B	DC	EXT	50 mV up to 150 mV
EXT dtb	100 MHz	B	DC	EXT	50 mV up to 150 mV

- Remove the input signal.

3.4.12. Jitter

- Depress push-button A of the display-mode controls (S1)
- Depress push-button DELAY
- Set the delay to 9.00 - 3. with the SET potentiometer.
- Push the TB MAGN switch to position x1
- Depress push-button DEL'D TB of the X deflection controls (S2)
- Set the d.t.b. TIME/DIV switch to 1 μs and its vernier to CAL
- Set the m.t.b. TIME/DIV switch to 1 ms and its vernier to CAL
- Depress push-button AUTO of trigger-mode controls
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Depress push-button MAIN TB of the d.t.b. trigger-source controls (S21)
- Apply a square-wave voltage for a trace height of 4 DIV, repetition rate 20 μs, to the channel A input
- Adjust the m.t.b. LEVEL control for a stable, triggered display
- Check that the time jitter does not exceed 0,3 DIV
- Depress push-button A of the d.t.b. trigger-source controls (S21)
- Check that a jitter-free display can be obtained, setting the d.t.b. LEVEL control
- Remove the input signal.

3.4.13. Periodic and random deviations

These must be measured only with the cabinet plates fitted

- Inputs of channels A and B open
- Depress push-buttons AC of the signal-coupling controls
- Set both AMPL switches to 2 mV/DIV and their verniers to CAL
- Depress push-button MAIN TB of the X deflection controls (S2)
- Depress push-button AUT of the trigger-mode controls
- Measure the periodic and random deviations in accordance with the following table:

Ripple	¼ SUBDIV at maximum
Noise	¼ SUBDIV at maximum
Microscopy	¼ SUBDIV at maximum
Converter interference	¼ SUBDIV at maximum
Instability of the trace	¼ SUBDIV at maximum
Parasitic Z modulation must not be visible	

3.4.14. Effect of the mains voltage variations

- Depress push-button CHOP of the display-mode controls (S1)
- Depress push-button MAIN TB of the X deflection controls (S2)
- Pull the TB MAGN switch to x10
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL
- Set the d.t.b. TIME/DIV switch to OFF
- Depress push-button AUTO of the trigger-mode controls
- Set both AMPL switches to 0.5 V/DIV and their verniers to CAL
- Depress push-buttons AC of the signal-coupling controls
- Interconnect the CAL socket and inputs A and B
- Vary the mains voltage by.+ and – 10 %
- Check that neither trace height nor trace width changes and that the briliance remains the same

3.4.15. Horizontal amplifier

3.4.15.1. Bandwidth

- Depress push-button B of the display-mode controls (S1)
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Push the TB MAGN switch to x1
- Depress push-button A of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave voltage of 3 $V_{p\text{-}p}$, frequency 2 kHz, to the channel A input
- Check that the trace width is 6 DIV
- Increase the frequency of the input signal to 2 MHz
- Check that the trace width is at least 4,2 DIV

3.4.15.2. Phase difference

- Depress push-button CHOP of the display-mode controls (S1)
- Push the Y POSITION controls to NORMAL
- Set both AMPL switches to 5 mV/DIV and their verniers to CAL
- Depress push-buttons DC of the signal-coupling controls
- Depress push-button EXT X DEFL of the X deflection controls (S2)
- Depress push-button A (B) of the m.t.b. trigger-source controls (S22)
- Apply a sine-wave voltage of 30 $mV_{p\text{-}p}$, frequency 100 kHz, to both input A and B
- Check that the phase difference does not exceed 3 ° (see Fig. 3.28.) in which $\frac{B}{A}$ equals the sine of the phase error angle.

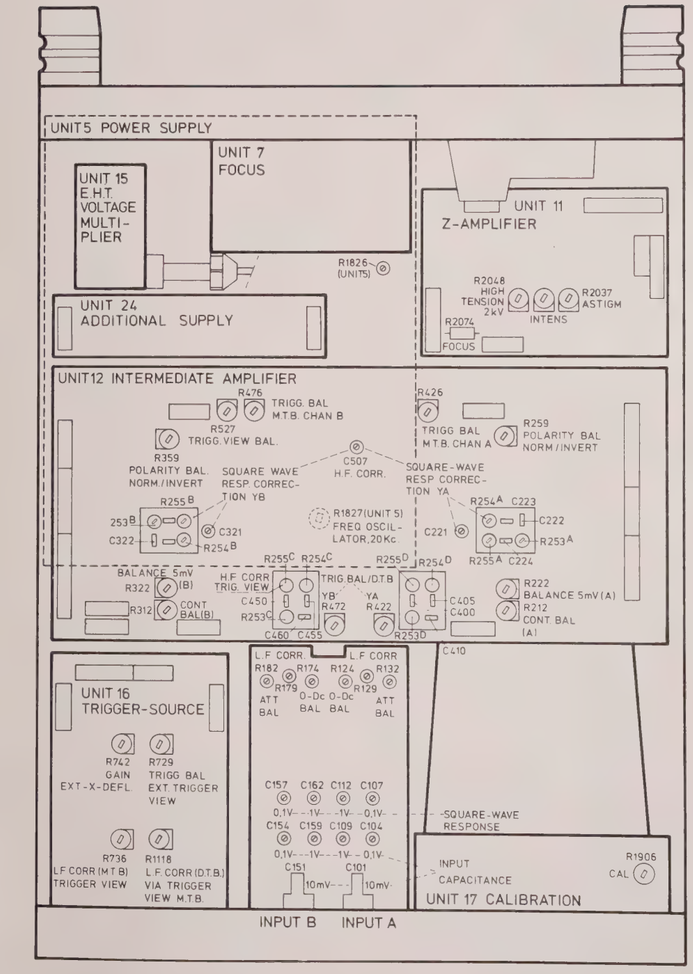


Fig. 3.29. Bottom view with adjusting references

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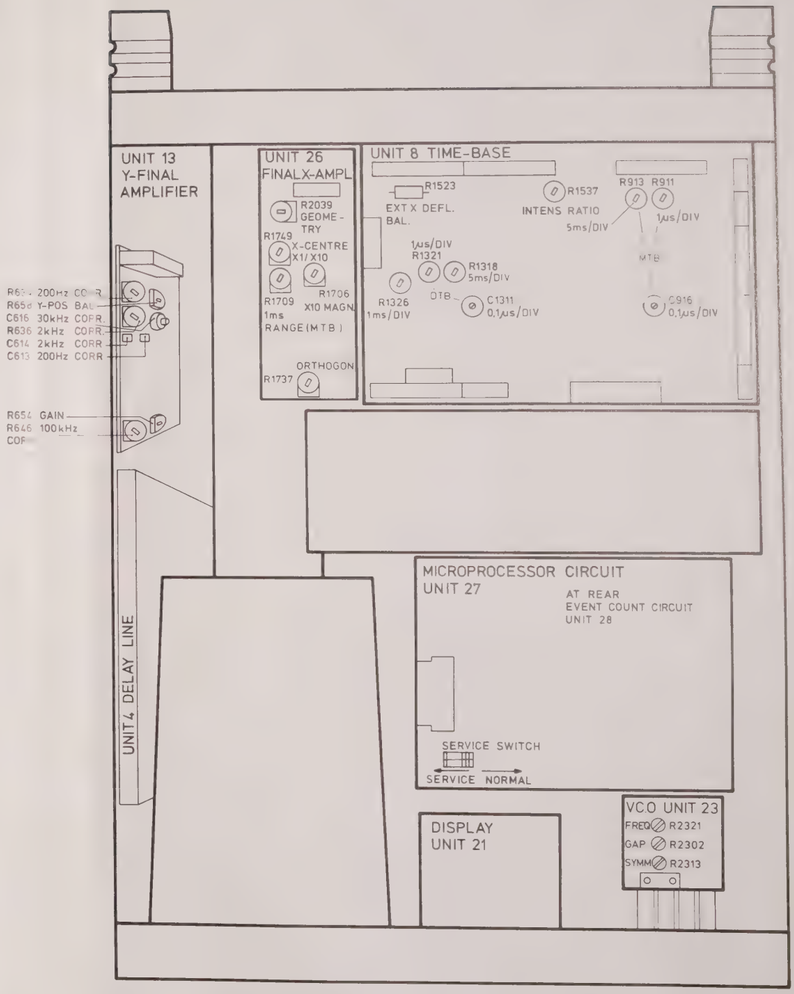


MAT 174

Fig. 3.30. Top view with adjusting references

3.5. MAINTENANCE

The oscilloscope PM 3263 generally requires no maintenance, as the instrument has no components that are subject to wear.

However, to ensure reliable and troublefree operation, the instrument should not be exposed to moisture, heat, corrosive elements or excessive dust.

Cleaning the Nextel suède coating:

WARNING: The Nextel suède coating is ethanol-resistant, but is susceptible to methylated spirit, which will attack the surface (due to one of the de-naturing substances).

The bright appearance of the amplifier cabinet, lacquered with Nextel suède coating will deteriate after some time as the surface becomes soiled. Cleaning with a cloth soaked in water, ethanol or a common household cleansing agent does not always restore this lustre and leaves dirt in the holes and the pores.
The 3M Company have developed a new cleansing pad (White Cleansing Pad, Catalogue No. 8440) which when soaked in water, ethanol or a common household cleansing agent will also penetrate holes and pores.
This method is similar to that of abrasive cleaning pads but lacks their abrasive action.
Abrasive cleaning pads should not be used, otherwise surface scratches will result.

3.6. TEST AND REPAIR HINTS

The ROM memory which is in the micro-processor circuit contains except the normal working program also a test program.

This test program consists of so-called:

- Non-selectable tests
- Selectable tests

Non-selectable tests

These tests are included in the start procedure of the normal working program. They are the so-called power-on tests.
These tests are automatically carried-out every time the instrument is switched on.
These tests include:

- Processor test
- PROM test
- RAM test
- Display test.

Selectable tests

These are stand-alone test routines. To initiate these tests a pair of switches located on the μP p.c. unit must be put in the test position.

(one switch selects the test mode;
the other one inhibits the watchdog

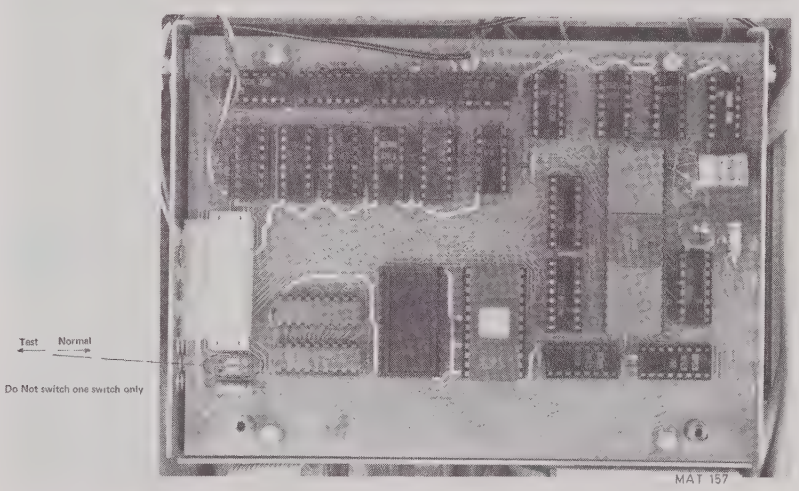


Fig. 3.31. Location of Service mode switch on microprocessor unit (unit 27).

In this mode the desired test can be selected with the SET knob.
The LED display shows successively the word TEST with number 0 ... 4.
Each TEST number remains on the display during approx. 1 sec.
If during the test number indication the SET knob is pressed, that specific test has been selected.

TEST 0 = Static display test
TEST 1 = Event counter Load/End test
TEST 2 = Delay counter End test
TEST 3 = Bus High test
TEST 4 = Bus Low test.

Note: If the circuit is in the test mode when switching-on, also the power-on test is executed.

If TEST 3 or TEST 4 has been selected the only way to get out-of these tests is temporary switching-off the mains voltage.

There are two display tests, one in the power-on routine showing a 8 in each digit for half a second successively and one in the test mode (TEST 0) which gives a stable 8 display.

3.6.1. Power on tests

Processor test

A few instructions are executed to test whether the processor is in working condition. If so a ☐ is shown in the right most digit of the display. (only for a short moment because the processor proceeds with the next test).

PROM test

The PROM's checksum is calculated from the PROM's contents and compared with the stored checksum. If no error is found a / is shown in the right-most digit of the display (only for a short moment because the processor proceeds with the next test.

RAM test

The RAM storage capability is checked by writing certain test patterns in all RAM addresses and reading them again.
If an error is found the error byte is addressed permanently, and the / remains in the display.

Display test

Each digit in the display is showing an ⊟ for half a second.
At the end also the three LED's next to the LED display light up for half a second.

This completes the power-on tests.

3.6.2. Service tests

Following tests are selectable when the switch on the microprocessor unit has been put in the service (test) mode. (See Fig. 3.31.).

3.6.2.1. TEST 0 *Display test*

If the SET knob is pressed at the moment that the LED display shows TEST 0 the left most digit of the display shows an ⊟
After pressing again the SET knob digit lights up and so on.
Do not press the SET knob too shortly because then nothing happens.
Also the three led's next to the LED display are checked.
In this test the display unit can be checked.

3.6.2.2. TEST 1 *Event counter load/end test*

If the SET knob is pressed at the moment that the LED display shows TEST 1 the Event counter load/end test is initiated.
This test is divided in seven test patterns which are selected by successively pushing the SET knob.
The test number is indicated in the LED display.

This test is a help for checking the latches and counters in the event counter circuit.

In this test certain bit patterns are loaded into latches D2413 ... D2418.

Patterns 1 and 2 serve to test these latches.
Patterns 3 ..... 7 serve to check the counters and the "count-ready" decoding circuits.

Patterns 1 and 2

Patterns of alternate 1's and 0's are loaded into the latches and can be checked on the latches outputs.
(A logic probe can be used).

– *Pattern 1*

A bit pattern of AAAAA (Hexadecimal) is loaded into the latches.
The levels on the outputs of the latches must be:

	D2413 ... D2417	D2418
point 9	1	0
point 10	0	1
point 15	1	0
point 16	0	1

– *Pattern 2*

A bit pattern of 55555 (Hexadecimal) is loaded into the latches.
The levels on the outputs of the latches must be:

	D2413 ... D2417	D2418
point 9	0	1
point 10	1	0
point 15	0	1
point 16	1	0

Patterns 3, 4, 5, 6 and 7

In these test various bit patterns are applied to the latches so that the corresponding number of pulses to be counted have a successively ratio of approx. 10:1.
The number of pulses to be counted is the 9-complement of the bit pattern applied to the latches.
In these tests the ripple count outputs and the min/max outputs of the counters can be checked.
After counting the number of pulses, the "count ready" pulse (p.14 of D2419) goes from "1" to "0" and remains "0" until the beginning of the hold-off pulse.

Above signals can be measured with the oscilloscope itself or another one.
Use the end edge (which is negative going) of the hold-off signal which is present on p.10 or p.12 of D2401 as trigger source.

– Set the beginning of the MTB sweep at the first vertical graticule line.
– Apply an Y-signal of 1 MHz.
– Select the TRIG mode.
– Set the MTB TIME/DIV switch so that the number of events to be counted remains within the 10 divisions MTB sweep.

– *Pattern 3*

Latches input bit pattern: 09990 (Hexadecimal).
Corresponding number of pulses to be counted: 90009.
Set the MTB TIME/DIV switch to 10 ms/DIV and check that the DTB starts at the end of the 9th division.

– *Pattern 4*

Latches input bit pattern: 90004 (Hexadecimal).
Corresponding number of pulses to be counted: 9995.
Set the MTB TIME/DIV switch to 1 ms/DIV and check that the DTB starts at the end of the 10th division.

– *Pattern 5*

Latches input bit pattern: 99008 (Hexadecimal).
Corresponding number of pulses to be counted: 991.
Set the MTB TIME/DIV switch to 0,1 ms/DIV and check that the DTB starts at the end of the 10th division.

– *Pattern 6*

Latches input bit pattern: 99904 (Hexadecimal).
Corresponding number of pulses to be counted: 95.
Set the MTB TIME/DIV switch to 10 μs/DIV and check that the DTB starts in the middle of the 9th division.

– *Pattern 7*

Latches input bit pattern: 99998 (Hexadecimal).
Corresponding number of pulses to be counted: 1.
Set the MTB TIME/DIV switch to 1 μs/DIV and check that the DTB starts at the beginning of the 2nd division (so after 1 counting pulse).

3.6.2.3. **TEST 2** *Delay counter end test*

If the SET knob is pressed at the moment that the LED display shows TEST 2, the delay counter end test is initiated.
This test is divided in four test patterns which are selected by successively pressing the SET knob.
The test number is indicated in the LED display.

This test is a help for checking the counters and corresponding logic circuits in the dual d.a.c. circuit (these circuits are located on the microprocessor p.c. board).

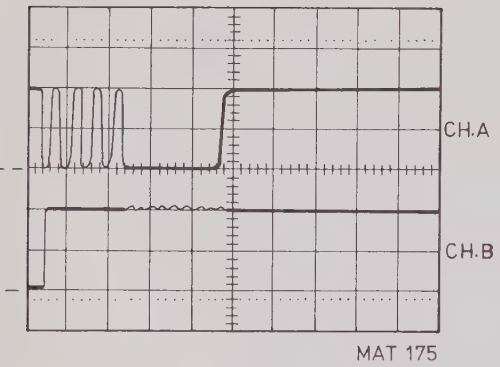
In this test certain bit patterns are loaded into the counters D2601 ... D2604.

The status of the corresponding outputs is given in the following table.
Except for the D2604 outputs in pattern 1 a logic probe can be used.
The D2604 outputs in pattern 1 must be checked with a two channel oscilloscope.
This oscilloscope must be triggered with the $\overline{\text{LOAD 2}}$ signal, applied to channel B.

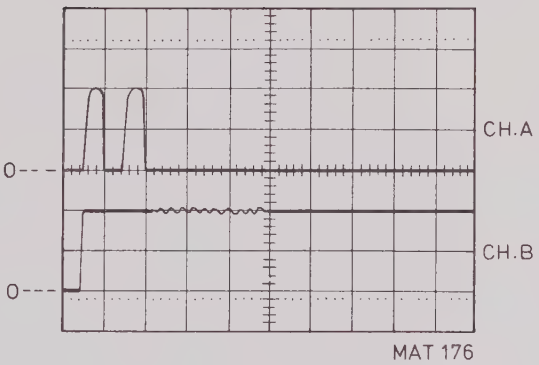
Set the MTB TIME/DIV switch to 2 μs/DIV and the ch. A and ch. B AMPL/DIV switches to 2 V/DIV.

The signal at the outputs of D2604, applied to channel A are shown in Fig. 3.32.

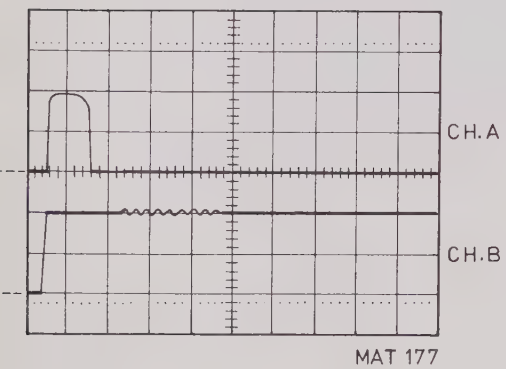
	Pattern 1	Pattern 2	Pattern 3	Pattern 4
Applied bit-pattern (Hexadecimal)	C009	3999	A000	4000
D2601 – p.3	0	1	0	0
p.2	0	1	1	0
p.6	1	0	0	1
p.7	1	0	1	0
D2602 – p.3	0	1	0	0
p.2	0	0	0	0
p.6	0	0	0	0
p.7	0	1	0	0
D2603 – p.3	0	1	0	0
p.2	0	0	0	0
p.6	0	0	0	0
p.7	0	1	0	0
D2604 – p.3		1	0	0
p.2	See	0	0	0
p.6	text	0	0	0
p.7		1	0	0



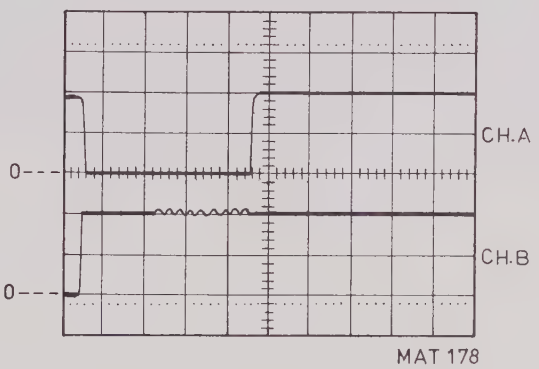
D2604 pin 3.



D2604 pin 2

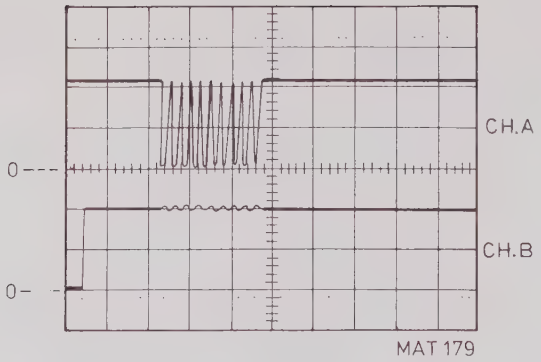


D2604 pin 6.



D2604 pin 7.

Fig. 3.32. D2604 output signals pattern 1.



D2607 p 6,8

Fig. 3.33. Terminal count signal (T.C.) pattern 1.

Fig. 3.33. shows the Terminal Count signal at points 6 and 8 of D 2607 in pattern 1.

During patterns 2 and 3 these points are continuously "0"; in pattern 4 the clock signal is present at these points.

3.6.2.4. **TEST 3** *Bus -high test*

If the SET knob is pressed at the moment that the LED display shows TEST 3, the Bus-high test is initiated.
In this test all address-and data lines are high during the write-cycle of the micro-processor.
Use the $\overline{WR}$ output of the micro-processor for triggering
With this test also the circuits close to the micro-processor circuit can be checked.

NOTE: – Due to the fact that all "1" 's are written the LED display cannot show the test number but remains dark.

– Pressing the SET knob has no further effect. The only way to get out of this test is to switch off the mains switch for a moment.

3.2.6.5. **TEST 4** *Bus-low test*

If the SET knob is pressed at the moment that the LED display shows TEST 4 the Bus-low test is initiated. This test is identical to TEST 3 except that now all address and data lines are low during the write-cycle of the microprocessor.
Also escaping from this test is only possible by switching off the mains for a short moment.

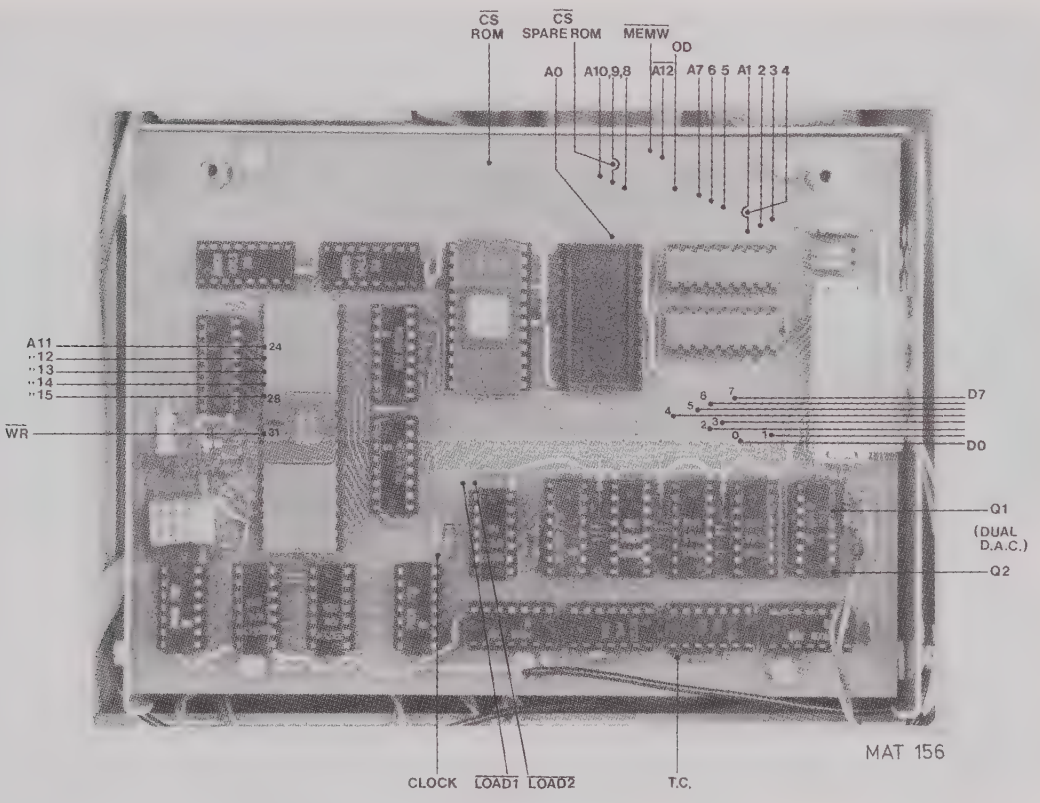


Fig. 3.34. Microprocessor printed circuit board

3.7. INFORMATION CONCERNING ACCESSORIES

3.7.1. Attenuator probe set delivered with the instrument

This 10x attenuator probe is designed for real time oscilloscopes up to 250 MHz, having a BNC input jack and 13 pF ± 3 pF input capacitance paralleled by 1 MΩ. The PM 8935L is a similar probe with a cable length of 2,5 metres.

3.7.1.1. Specifications

Electrical

Attenuation	10x ± 2 % (Oscilloscope input 1 MΩ ± 1 %)
Input resistance d.c.	10 MΩ ± 2 % (Oscilloscope input 1 MΩ ± 5 %)
a.c.	See curve Fig. 3.35.
Input capacitance d.c. and l.f.	11 pF ± 1 pF (Oscilloscope input 1 MΩ ± 5 % paralleled by 13 pF ± 3 pF)
Input resistance h.f.	See curve Fig. 3.35.
Bandwidth	Probe has negligible effect on oscilloscope bandwidth
Max. input voltage	500 V d.c. + a.c. $_{peak}$, derating with frequency. See Fig. 3.36. Oscilloscope input 1 MΩ and voltage applied between probe tip and earthed part of probe body. Test voltage 1500 $V_{d.c.}$ during 1 s, at a temperature between 15 and 25 °C, a rel. hum. of 80 % at maximum and at sea level.
Check zero button on probe shell	Same function as 0 position of input coupling switch on oscilloscope

Environmental

Probe operates within specifications over the following ranges:

Temperature	−25 °C to +70 °C
Altitude	Up to 5000 metres (15000 feet)
Other environmental data	Same as for the oscilloscope the probe is used with

Mechanical

Dimensions	Probe body 103 mm x 10 mm dia (max.) Cable length 1500 mm or 2500 mm Correction box 55x30x15 mm incl. BNC
Mass	Incl. standard accessories 125 g.

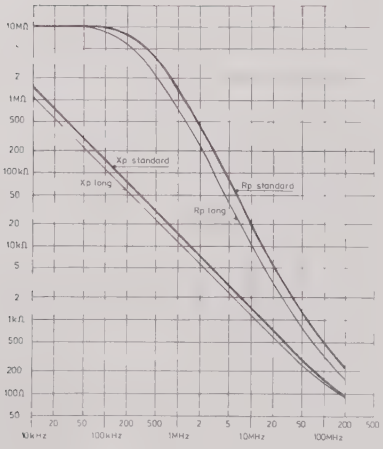


Fig. 3.35. Input resistance (R_p) and reactance (X_p) versus frequency.

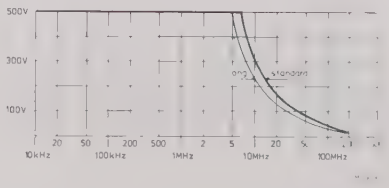


Fig. 3.36. Max. AC component of input voltage as a function of frequency.

3.7.1.2. Adjustments

Matching the probe to your oscilloscope

The measuring probe has been adjusted and checked by the manufacturer. However, to match the probe to your oscilloscope, the following manipulation is necessary.
Connect the measuring pin to the CAL socket of the oscilloscope
A trimmer C2 can be adjusted through a hole in the compensation box to obtain optimum square-wave response. See Fig. 3.37.

Fig. 3.37. Adjusting C2

Adjusting the h.f. step response

The h.f. step-response correction network has been adjusted by the manufacturer to match an average oscilloscope input. For optimum pulse response, however, the probe can be adjusted to match your particular oscilloscope. Later readjustment is only necessary if the probe is to be used with a different type of oscilloscope, or after replacement of an electrical component.
For the adjustment, proceed as follows.
Connect the probe to a fast pulse generator (rise time not exceeding 1 ns) which is terminated by its characteristic impedance. Dismantle the compensation box as described in section 3.7.1.3. Set the generator to 100 kHz. Adjust C3, C4, R2, R4 and R5 alternatively to obtain a display as shown in Fig. 3.38. a.
It is important that the leading edge is as steep, and the top is as flat, as possible. Incorrect settings of C3, C4 R2, R4 and R5 give rise to pulse distortions as shown in Fig. 3.38. b and 3.38. c.

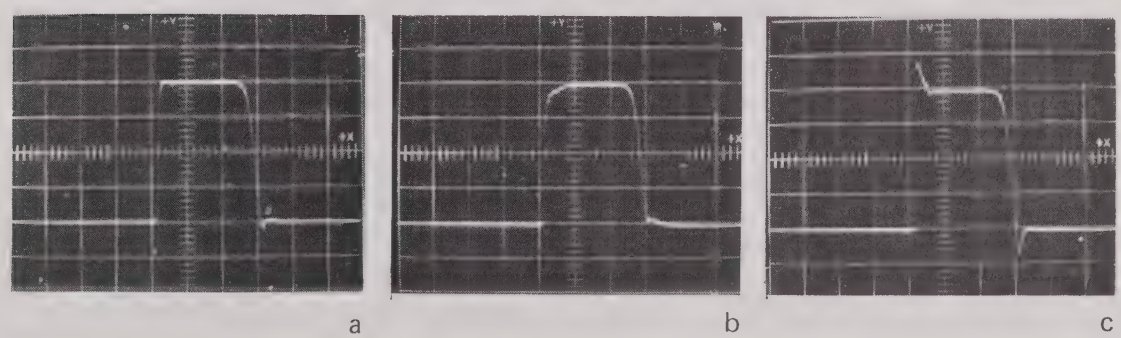


Fig. 3.38. Adjusting the h.f. step response

3.7.1.3. Dismantling

Dismantling the probe (see Fig. 3.39.)

The front part 11 of the probe can be screwed from the rear part 13. Item 11 can then be slid from 12 and 13. The RC combination 12 is soldered to 13. For replacement of 12 refer to section 3.7.1.4.

Dismantling the compensation box (see Fig. 3.39.).

Unscrew the ribbed collar of the compensation box to the cable. The case 14 can then be slid of the compensation box sideways. The electrical components on the printed-wiring board are then accessible.

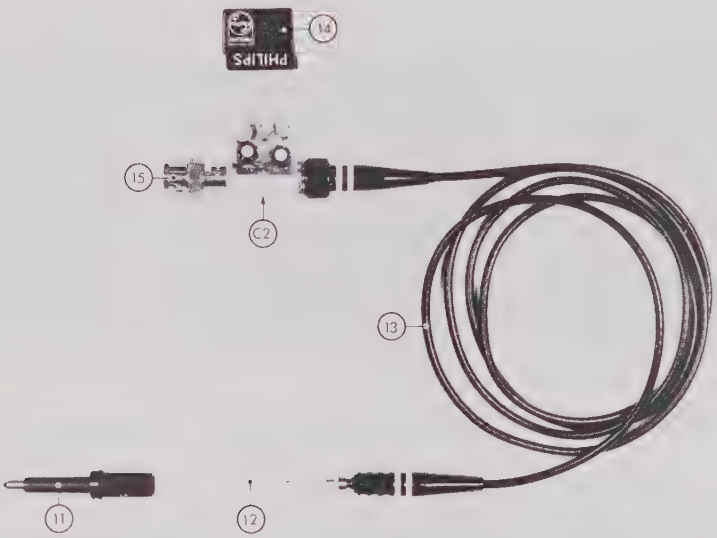


Fig. 3.39. Dismantling.

3.7.1.4. Replacing parts

Assembling the probe

A new RC network is slid over the cable nipple after which the cable core is soldered on to the resistor wire. When the measuring probe is assembled, the RC network must be at dead centre in the probe tip.

Replacing the cable assembly

Dismantle the compensation box as described in section 3.7.1.3.
Unsolder the connection between the inner conductor and the printed-wiring board. Keep the frame of the compensation box steady and loosen the cable nipple with a 5 mm spanner on the hexagonal part. Replace the cable and fit it working in the reverse order.

Replacing the BNC

Dismantle the compensation box as described in section 3.7.1.3.
Unsolder the connection to the printed-wiring board. Keep the frame of the compensation box steady and loosen the BNC with a 3/8 inch spanner. Replace the BNC and fit it working in the reverse order.

Replacing the probe tip

The damaged tip can be pulled out by means of a pair of pliers. A new tip must be firmly pushed in.

3.7.1.5. Parts lists

Mechanical parts (see Fig. 3.39. and 3.40.)

Item	Order number	Qty	Description
1	5322 321 20223	1	Earth cable
2	5322 256 94136	1	Probe holder
3	5322 255 44026	5	Soldering terminals which may be incorporated in circuits as routine test points
4	5322 532 64223	2	Marking ring red
5	5322 532 64224	2	Marking ring white
	5322 532 64225	2	Marking ring blue (not shown)
6	5322 268 14017	2	Probe tip
7	5322 462 44319	1	Insulating cap to cover metal part of probe during measurements in densely wired circuits
8	5322 462 44318	2	Cap facilitating measurements on dual-in-line integrated circuits
9	5322 264 24018	1	Wrap pin adapter
10	5322 264 24019	1	Spring-loaded test clip
11	5322 264 24021	1	Probe shell with check-zero button
12	5322 216 54152	1	RC network PM 8935
	5322 216 54153	1	RC network PM 8935L
13	5322 320 14063	1	Cable assy PM 8935
	5322 320 14064	1	Cable assy PM 8935L
14	5322 447 64015	1	Cap
15	5322 268 44019	1	BNC connector

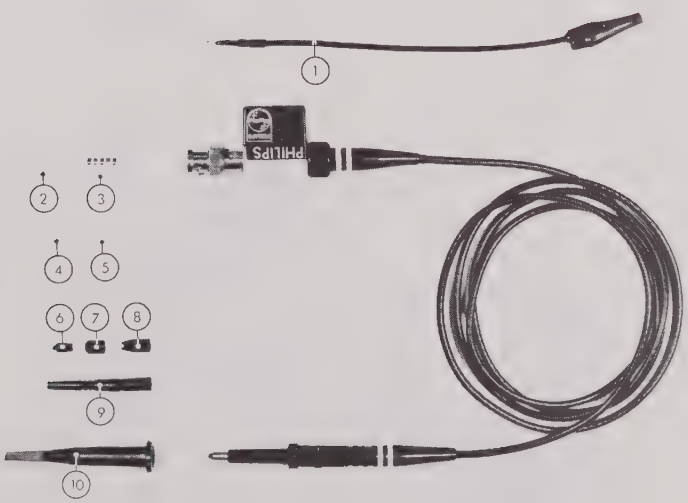


Fig. 3.40. Mechanical parts

Electrical parts (Fig. 3.41.)

Item	Order number	Description
C1	–	Part of RC network (not supplied separately)
C2	5322 125 54003	Trimmer 60 pF, 300 V
C3	5322 125 50048	Trimmer 3,5 pF, 300 V, PM 8935
C4	5322 125 50051	Trimmer 18 pF, 300 V
L1	–	Coil (not supplied)
R1	–	Part of RC network (not supplied separately)
R2	5322 100 10135	Potmeter 470 Ω, 20 %
R3	5322 116 50536	Metal film resistor 464 Ω, 1 %, MR25
R4	5322 100 10135	Potmeter 470 Ω, 20 %
R5	5322 100 10143	Potmeter 1 kΩ, 20 %

If a complete new probe is required, type PM 8935 must be ordered.

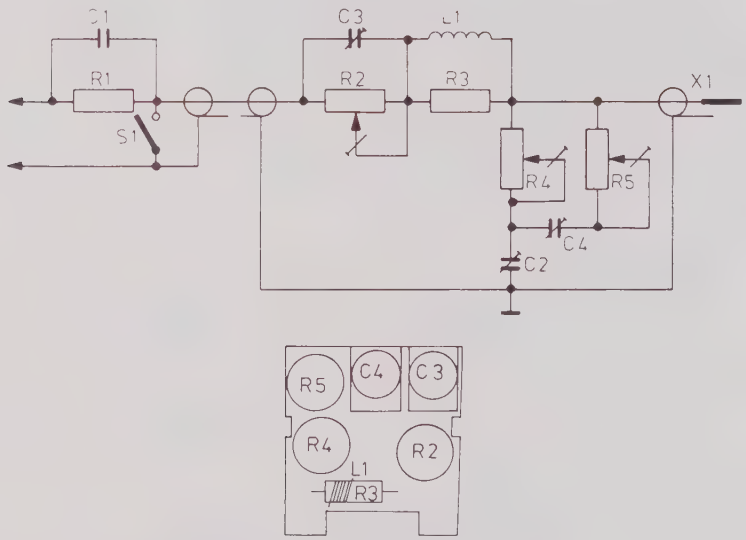


Fig. 3.41. Electrical parts

3.7.2. Adapter PM 9051

This is an adapter to make a BNC socket suitable for the connection of two 4 mm banana plugs.

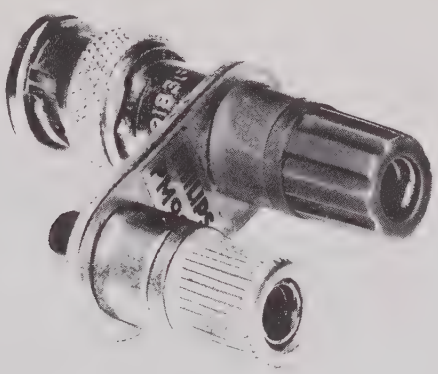


Fig. 3.42. Adapter PM 9051

3.7.3. Trimming Tool Kit (Type 800/NTX)

This useful kit contains 3 twin-coloured holders, 2 extension holders and 21 interchangeable trimming pins.

The wide variety of pins allows almost every type of trimming function to be carried out in instruments to be calibrated (e.g. measuring instruments, radio and T.V. sets).

Ordering number: 4822 310 50015
(A spare set containing the 8 most commonly used pins is available under the Ordering number: 4822 310 50016).

Fig. 3.43. Trimming tool kit

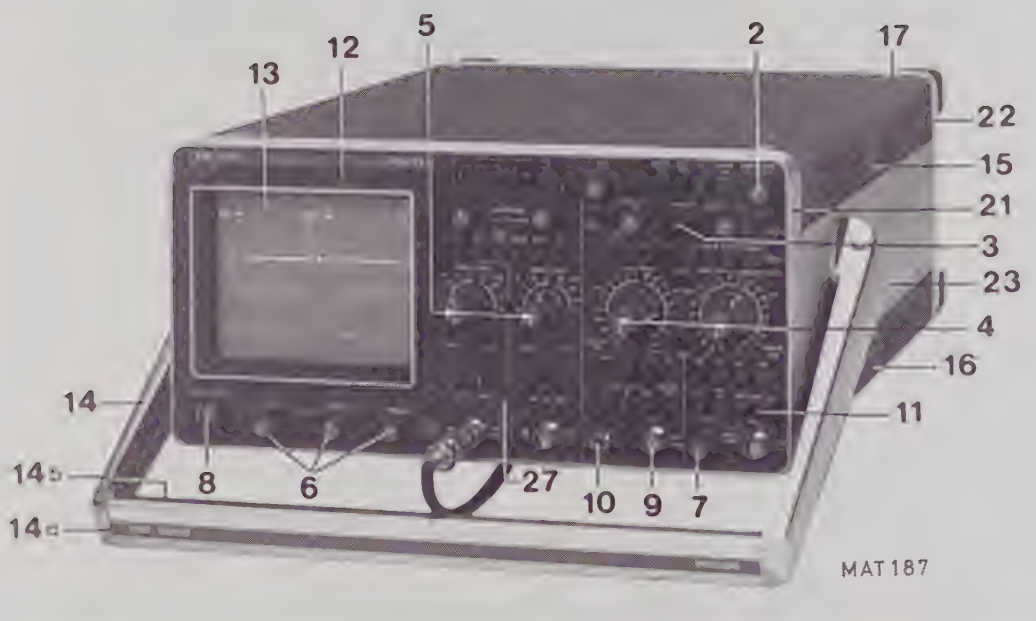


Fig. 3.44. Front view showing item numbers

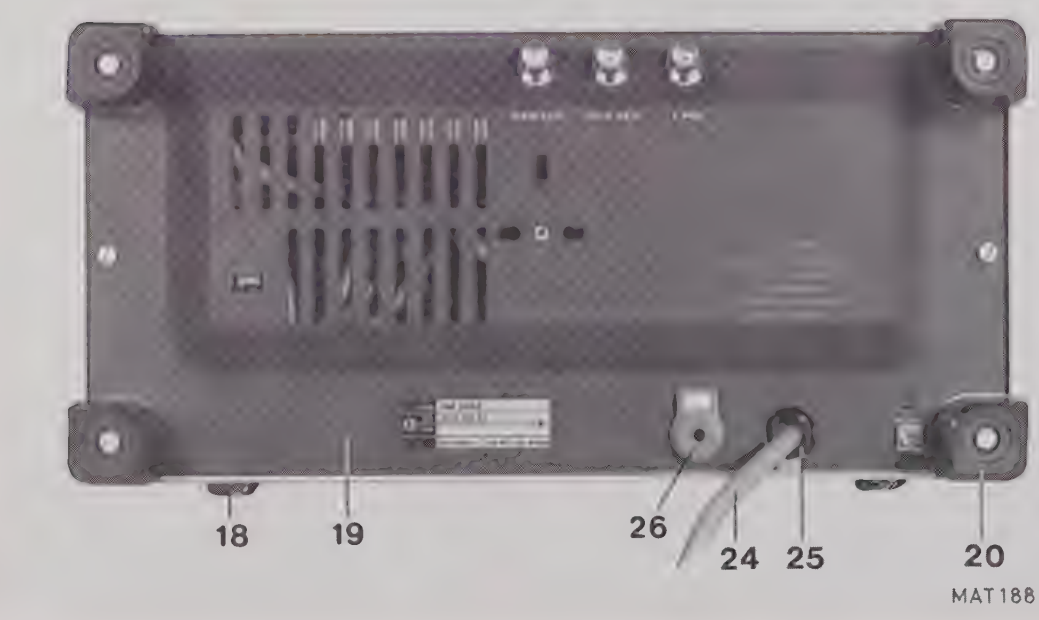


Fig. 3.45. Rear view showing item numbers

3.8. PARTS LIST AND DIAGRAMS
(Subject to alteration without notice)

3.8.1. Mechanical parts (see Fig. 3.44. and 3.45.)

Item	*Qty.*	*Order number*	*Description*	*Used for:*	
				R1/S24	SET (Down-stop- Up)
2	5	5322 414 34091	Knob, dia 10 mm, shaft dia 4 mm	R2/S3	POSITION, TB MAGN
2	5	5322 414 74015	Cover, grey with dash	R3/S4	POSITION, PULL TO INVERT A
				R4/S5	POSITION, PULL TO INVERT B
				R5/S6	LEVEL/SLOPE DTB
				R7/S7	LEVEL/SLOPE MTB
3	1	5322 414 34217	Knob, dia 6, 7-10 mm, shaft dia 4 mm	R6	TRACE SEPARATION
3	1	5322 492 64337	Clamping spring		
4	2	5322 414 34081	Knob, dia 24 mm, shaft dia 6 mm	S13/R10/S14	TIME/DIV DTB
4	2	5322 414 34119	Knob, dia 14 mm, shaft dia 4 mm	S15/R11/S16	TIME/DIV MTB
4	2	5322 414 74016	Cover, blue with dash		
5	2	5322 414 34079	Knob, dia 18,7 mm, shaft dia 6 mm	S9/R8/S10	AMPL/DIV A
5	2	5322 414 34091	Knob, dia 10 mm, shaft dia 4 mm	S11/R9/S12	AMPL/DIV B
5	2	5322 414 74029	Cover, blue with dash		
6	3	5322 414 34134	Knob, dia 10 mm	R14/S24	ILLUM/POWER ON-OFF
6	3	5322 492 64337	Clamping spring	R16	INTENS
6	3	5322 414 74015	Cover, grey with dash	R17	FOCUS
7	1	5322 414 34091	Knob, dia 10 mm, shaft dia 4 mm	R18	X-AMPL/HOLD OFF
7	1	5322 414 74028	Skirt		
7	1	5322 414 74015	Cover, grey with dash		
8	1	5322 267 14014	Socket	X1/X2	CAL
8	1	5322 505 14184	Plastic nut		
8	1	5322 405 94073	Current loop		
–	1	5322 263 54003	BNC adapter for CAL socket		
9	5	5322 267 10004	BNC socket	X3	A input
				X4	B input
				X6	DTB EXT TRIG. input
				X7	MTB EXT TRIG. or X DEFL input
				X8	MTB gate output
				X9	DTB Gate output
				X10	Z-MOD input
10	1	5322 535 80523	Earth socket	X5	
10	1	5322 505 14178	Serrated nut		

Item	Qty.	Order number	Description	Used for:
11	34	5322 414 14011	Knob	Push-button switches
12	1	5322 466 74059	Bezel	
13	1	5322 480 34046	Contrast filter, grey	
13	1	5322 480 34074	Contrast filter, blue	
14	1	5322 498 54082	Set grip and brackets	Carrying handle
14a	1	5322 455 84077	Strip with type nr. (blue)	
14b	1	5322 460 64044	Explanatory strip englisch	
–	1	5322 447 94169	Front cover, complete	
15	1	5322 447 94482	Upper cabinet plate, complete	
16	1	5322 447 94483	Lower cabinet plate, complete	
17	4	5322 417 24024	Quick fastener, complete	Cabinet plates
18	4	5322 462 44297	Rubber foot	Lower cabinet plate
19	1	5322 447 94524	Rear cabinet plate	
20	4	5322 462 44154	Nylon foot, complete	Rear side
21	1	5322 447 94143	Cast aluminium front plate	
22	1	5322 447 94504	Cast aluminium rear plate	
23	1	5322 460 64042	Aluminium side strip left	Cabinet
23	1	5322 460 64043	Aluminium side strip right	Cabinet
–	8	4822 502 30047	Screw	Aluminium side strip
–	–	4822 505 10029	Square nut M3	In aluminium side strip
24	1	5322 321 14066	Mains cable	
25	1	5322 325 64061	Cable cleat	Fixing the cable in the rear plate
–	1	4822 253 30025	Fuse, 2A slow blow	Mains fuse
26	1	5322 256 34081	Fuseholder	
–	–	5322 255 44088	Holder for LED	
–	2	5322 255 24015	Lampholder	Graticule illumination
–	6	5322 405 94074	Male clamping piece	Fixture for push button
–	6	5322 405 94075	Female clamping piece	Switch assy's
–	6	4822 502 11142	Screw M3X20	
–	–	5322 405 94171	Complete set of clamping pieces	
–	4	5322 462 44153	Rubber clamping buffer	C.R.T. front
–	1	5322 535 94656	Plastic spindle	R14 ILLUM
–	1	5322 532 24389	Coupling piece	
–	2	5322 505 14185	Special nut	Attenuator switch
–	–	5322 395 54023	Tool	Special attenuator nut
–	4	5322 505 14186	Special nut	LEVEL/SLOPE and POSITION potentiometers
–	–	5322 395 54024	Tool	Above mentioned special nut
–	–	5322 276 14158	Single push-button switch	
–	–	5322 320 14102	Set of coaxial cables	
–	–	5322 268 24116	Coaxial socket, vertically mounted on p.c. boards	
–	–	5322 268 14141	Contact pin for coax. socket	
27	1	5322 455 84076	Textplate PM 3263	Front panel
–	–	4822 390 20023	Grease (Dow Corning"4 Compound" Silicon Dielectric; MIL.S.8660B)	EHT connector
–	–	5322 390 34006	Coating (Dow Corning 3140 RTV coating)	FOCUS unit
–	–	4822 266 30071	3-pole plug (Stocko MKF 803-1-0-303)	
–	–	4822 265 30121	3-pole socket (Stocko MKS 823-1-0-303)	
–	–	4822 266 30072	4-pole plug (Stocko MKF 804-1-0-404)	
–	–	4822 265 30119	4-pole socket (Stocko MKS 824-1-0-404)	
–	–	4822 266 30073	6-pole plug (Stocko MKF 806-1-0-606)	
–	–	4822 265 30117	6-pole socket (Stocko MKS 826-1-0-606)	
–	–	4822 266 40057	7-pole plug (Stocko MKF 807-1-0-707)	
–	–	4822 265 40119	7-pole socket (Stocko MKS 827-1-0-707)	

Item	*Qty.*	*Order number*	*Description*	*Used for:*
—	1	5322 276 64035	Vertical mode switch S1	
—	1	5322 276 44078	Horizontal mode switch S2	
—	1	5322 276 84072	DTB mode switch S8 + S25/S28	
—	2	5322 273 34116	Switch segment S9/S11	
—	1	5322 273 14057	DTB TIME/DIV Switch S13/14	
—	1	5322 273 14056	MTB TIME/DIV Switch S15/16	
—	1	5322 276 84063	DTB/MTB trig. mode sw. S19/20	
—	1	5322 276 84063	DTB/MTB trig. source sw. S21/S22	
—	1	5322 693 84003	UNIT 2. Vertical. att. compl.	
—	1	5322 216 54202	Vertic. att. pc board	
—	1	5322 278 94078	Vertic. att. int contact array	
—	1	5322 121 44247	UNIT 3 Mains filter	
—	1	5322 320 44039	UNIT 4 Delay line	
—	1	5322 216 54204	UNIT 5 Power supply	
—	1	5322 216 54206	UNIT 7 Focus unit	
—	1	5322 216 54205	UNIT 8 Time-base unit	
—	1	5322 216 54207	UNIT 9 Trigg. ampl. pc board	
—	1	5322 216 54203	UNIT 11 Z-ampl. pc board	
—	1	5322 216 54208	UNIT 12 Int. ampl. p.c. board	
—	4	5322 216 54198	Adj. pc board for unit 12	
—	1	5322 216 54197	UNIT 13 Vert. fin. ampl. pc board	
—	1	5322 219 84132	UNIT 15 EHT unit	
—	1	5322 216 54209	UNIT 16 Trig. source pc board	
—	1	5322 216 54201	UNIT 17 Cal. gen. pc board	
—	1	5322 216 54211	UNIT 21 Display unit	
—	1	5322 216 54212	UNIT 23 VCO unit	
—	1	5322 216 54213	UNIT 24 Add. power supply	
—	1	5322 216 54214	UNIT 26 X final ampl.	
—	1	5322 216 54215	UNIT 27 Micro. proc. unit	
—	1	5322 216 54216	UNIT 28 Event counter	

3.8.2. Electrical parts

3.8.2.1. Item numbers (e.g. C ... R .... V ....) have been divided in groups which relate to the circuit, the unit and the circuit diagram, according the following table.

Item number	Location	Unit number
1 ... 99	Front or rear plate of the instrument	–
100 ... 199	Y input attenuator and impedance converter	2
200 ... 599	Intermediate amplifier	12
600 ... 699	Final Y amplifier	13
700 ... 799	Ext. input m.t.b.	16
800 ... 899	Trigger circuit m.t.b.	9
900 ... 999	Sweep circuit m.t.b.	8
1000 ... 1099	Time/div. switch m.t.b.	8
1100 ... 1199	Ext. input d.t.b.	16
1200 ... 1299	Trigger circuit d.t.b.	9
1300 ... 1399	Sweep circuit d.t.b.	8
1400 ... 1499	Time/div switch d.t.b.	8
1500 ... 1549	X Deflection selector	8
1550 ... 1599	Voltage stabilaisator (T.B. circuitry)	8
1600 ... 1649	Display-mode logic	12
1650 ... 1699	Voltage stabilisator (intermed. ampl)	12
1700 ... 1799	Final X amplifier	8,26
1800 ... 1899	Power supply	5,15, 24
1900 ... 1999	Calibration generator	17
2000 ... 2099	Final Z amplifier	7, 8, 11, 17, 20, 26
2200 ... 2299	Display unit	21, 28
2300 ... 2399	VCO unit	23
2400 ... 2599	Event counter unit	28
2600 ... 2699	Mocroprocessor unit/trigger unit	9,27

Item	Ordering number	Farad	Tol (%)	Volts	Remarks
Capacitors					
C 101	5322 125 54026	3PF		400	TRIMMER
C 102	4822 121 40171	22NF	10	400	POLYESTER FOIL
C 103	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 104	5322 125 50048	3,5PF		300	TRIMMER
C 106	4822 122 31191	5,6PF	0,25PF	500	CERAMIC PLATE
C 107	5322 125 50051	18PF		300	TRIMMER
C 108	5322 122 34105	10PF		300	CERAMIC PLATE
C 109	5322 125 50049	18PF		300	TRIMMER
C 111	4822 122 31182	1PF	0,25PF	500	CERAMIC PLATE
C 112	5322 125 50051	39PF	5	50	TRIMMER
C 113	5322 122 34113				CERAMIC PLATE
C 114	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 116	5322 122 34103	5,6PF	0,5PF	50	CERAMIC PLATE
C 117	5322 122 34098	10NF	20	50	CERAMIC PLATE
C 118	4822 122 30105	1,5PF	0,25PF	100	CERAMIC PLATE
C 119	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 121	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 122	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 123	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 124	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 126	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 127	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 128	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 151	5322 125 54026	3PF		400	TRIMMER
C 152	4822 121 40171	22NF	10	400	POLYESTER FOIL
C 153	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 154	5322 125 50048	3,5PF		300	TRIMMER
C 156	4822 122 31191	5,6PF	0,25PF	500	CERAMIC PLATE
C 157	5322 125 50051	18PF		300	TRIMMER
C 158	5322 122 34105	33PF	10	50	CERAMIC PLATE
C 159	5322 125 50049	10PF		300	TRIMMER
C 161	4822 122 31182	1PF	0,25PF	500	CERAMIC PLATE
C 162	5322 125 50051	18PF		300	TRIMMER
C 163	5322 122 34113	39PF		50	CERAMIC PLATE
C 164	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 166	5322 122 34103	5,6PF	0,5PF	50	CERAMIC PLATE
C 167	5322 122 34098	10NF	20	50	CERAMIC PLATE
C 168	4822 122 30105	1,5PF	0,25PF	100	CERAMIC PLATE
C 169	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 171	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 172	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 173	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 174	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 176	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 177	5322 124 14069	6,8UF	-20+20	16	ELECTROLYTIC TANTALUM
C 178	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 201	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 202	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 204	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 205	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 206	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 207	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 208	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 209	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 210	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 211	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 212	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 213	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 214	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 215	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 216	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 217	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 218	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 219	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 220	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

C 221	5322 125 50049	100NF	10	250	TRIMMER
C 225	4822 122 30098	3,9NF	10	100	CERAMIC PLATE
C 226	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 227	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 228	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 229	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 231	4822 121 41161				POLYESTER FOIL
C 232	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 233	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 234	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 236	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 237	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 241	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 242	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 243	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 244	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 301	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 302	4822 122 31056	12PF	2	100	CERAMIC PLATE
C 303	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 304	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 305	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 306	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 307	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 308	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 309	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 310	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 311	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 312	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 313	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 314	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 315	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 316	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 317	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 318	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 319	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 321	5322 125 50049				TRIMMER
C 325	4822 122 30098	3,9NF	10	100	CERAMIC PLATE
C 326	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 327	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 328	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 329	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 331	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 332	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 333	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 334	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 336	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 337	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 341	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 342	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 343	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 344	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 400	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 401	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 402	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 404	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 408	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 409	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 411	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 414	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 417	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 418	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 450	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 451	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 452	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 454	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 458	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 459	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 461	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 464	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 466	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

C 467	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 468	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 501	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 502	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 503	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 504	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 506	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 507	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 508	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 509	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 601	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 602	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 603	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 604	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 606	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 608	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 609	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 611	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 616	5322 125 50051	18PF		300	TRIMMER
C 617	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 618	4822 122 30113	180PF	10	100	CERAMIC PLATE
C 620	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 621	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 622	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 623	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 624	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 625	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 626	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 628	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 629	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 700	4822 122 31184	1,5PF	0,25PF	500	CERAMIC PLATE
C 701	4822 122 31194	8,2PF	0,25PF	500	CERAMIC PLATE
C 702	5322 122 34094	82PF	2	100	CERAMIC PLATE
C 703	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 704	4822 121 40349	22NF	10	400	POLYESTER FOIL
C 705	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 706	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 707	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 708	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 709	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 710	4822 122 31217	3,9PF	0,25PF	500	CERAMIC PLATE
C 711	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 713	5322 122 34094	82PF	2	100	CERAMIC PLATE
C 714	4822 122 31215	0,68PF	0,25PF	100	CERAMIC PLATE
C 900	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 901	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 903	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 904	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 907	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 908	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 909	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 911	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 912	5322 121 40224	4,7µF	10	100	POLYESTER FOIL
C 913	5322 121 54108	47NF	1	63	POLYSTYRENE FOIL
C 914	5322 121 54062	4,3NF	1	63	POLYSTYRENE FOIL
C 915	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 916	5322 125 54003	60PF		300	TRIMMER
C 917	4822 121 50418	390PF	1	250	POLYSTYRENE FOIL
C 918	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 919	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 921	4822 124 20483	6,8UF	-10+50	40	ELECTROLYTIC
C 922	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 923	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 924	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 926	4822 121 40438	470NF	10	100	POLYESTER FOIL
C 927	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 928	4822 122 31164	1,8NF	10	100	CERAMIC PLATE
C 929	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 930	4822 122 31173	220PF	10	100	CERAMIC PLATE
C 931	4822 121 41161	100NF	10	250	POLYESTER FOIL

C 932	4822 122 31189	4,7PF	0,25PF	500	CERAMIC PLATE
C 1100	4822 122 31217	3,9PF	0,25PF	500	CERAMIC PLATE
C 1101	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 1102	4822 121 40349	22NF	10	400	POLYESTER FOIL
C 1103	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1104	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 1106	4822 122 31217	3,9PF	0,25PF	500	CERAMIC PLATE
C 1301	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1302	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1303	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1304	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1305	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1306	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1307	5322 121 40224	4,7µF	10	100	POLYESTER FOIL
C 1308	5322 121 54108	47NF	1	63	POLYSTYRENE FOIL
C 1309	5322 121 54062	4,3NF	1	63	POLYSTYRENE FOIL
C 1311	5322 125 54003	60PF		300	TRIMMER
C 1312	4822 121 50418	390PF	1	250	POLYSTYRENE FOIL
C 1313	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1314	4822 122 31177	470PF	10	100	CERAMIC PLATE
C 1315	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1316	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1317	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1318	4822 124 20483	6,8UF	-10+50	40	ELECTROLYTIC
C 1319	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1320	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1325	4822 122 31222	220PF	2	100	CERAMIC PLATE
C 1550	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1551	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1552	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1553	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1554	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1557	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1559	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1561	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1562	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1563	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1564	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1567	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1569	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1601	4822 122 31243	82PF	2	100	CERAMIC PLATE
C 1602	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1603	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1604	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1605	4822 122 31074	56PF	2	100	CERAMIC PLATE
C 1606	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1608	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1609	4822 124 20476	22UF	-10+50	25	ELECTROLYTIC
C 1611	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1612	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1650	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1651	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1652	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1653	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1654	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1656	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1658	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1659	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1660	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1661	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1662	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1663	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1664	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1666	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1667	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1668	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1669	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1671	4822 122 31174	2,7NF	10	100	CERAMIC PLATE
C 1672	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1673	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

C 1674	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1675	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1676	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1677	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1678	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1679	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1701	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1702	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1704	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1801	5322 121 44142	220NF	10	250	POLYESTER FOIL
C 1802	5322 124 44007	220UF	-10+50	350	ELECTROLYTIC
C 1803	5322 124 44007	220UF	-10+50	350	ELECTROLYTIC
C 1804	4822 121 40342	47NF	10	630	POLYESTER FOIL
C 1806	5322 122 54024	270PF	10	2000	CERAMIC DISK
C 1807	5322 121 44248	30,1NF	10	500	POLYESTER FOIL
C 1808	5322 121 44248	30,1NF	10	500	POLYESTER FOIL
C 1809	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1811	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 1812	5322 121 54049	3,3NF	1	63	POLYSTYRENE FOIL
C 1813	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1814	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1816	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1817	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1818	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1819	5322 124 24187	33UF	-20+20	16	ELECTROLYTIC
C 1821	5322 124 24099	22UF	-20+20	25	ELECTROLYTIC
C 1826	4822 122 31166	560PF	10	500	CERAMIC PLATE
C 1828	5322 124 24212	220UF	-20+20	6,3	ELECTROLYTIC
C 1829	5322 124 24212	220UF	-20+20	6,3	ELECTROLYTIC
C 1831	5322 124 24155	100UF	-20+20	16	ELECTROLYTIC
C 1832	5322 124 24155	100UF	-20+20	16	ELECTROLYTIC
C 1833	4822 121 40456	2,2µF	10	100	POLYESTER FOIL
C 1834	4822 121 40456	2,2µF	10	100	POLYESTER FOIL
C 1836	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1837	4822 121 40411	33NF	10	250	POLYESTER FOIL
C 1838	4822 121 41134	10NF	10	250	POLYESTER FOIL
C 1839	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1841	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1851	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1852	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1853	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1854	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1856	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1857	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1858	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1859	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1861	5322 122 54007	220PF	20	5000	CERAMIC DISK
C 1876	4822 124 20457	470UF	-10+50	6,3	ELECTROLYTIC
C 1877	4822 124 20476	22UF	-10+50	25	ELECTROLYTIC
C 1878	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1879	4822 122 31168	270PF	2	100	CERAMIC PLATE
C 1881	4822 124 20462	100UF	-10+50	10	ELECTROLYTIC
C 1882	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1901	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1902	5322 121 40233	680NF	10	100	POLYESTER FOIL
C 1903	4822 121 50611	20NF	1	63	POLYSTYRENE FOIL
C 1904	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2001	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 2002	4822 122 31052	8,2PF	0,25PF	100	CERAMIC PLATE
C 2003	4822 122 31052	8,2PF	0,25PF	100	CERAMIC PLATE
C 2004	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2007	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2009	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 2011	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 2012	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 2013	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2014	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 2015	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 2016	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 2017	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK

C 2018	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2019	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2021	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2022	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2026	5322 122 30134	10NF	-20+50	3K	CERAMIC PLATE
C 2028	5322 122 54007	220PF		3000	CERAMIC DISK
C 2029	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2030	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2031	5322 121 54044	1,8NF	1	63	POLYSTYRENE FOIL
C 2032	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 2033	4822 121 40435	390NF	1	100	POLYESTER FOIL
C 2034	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 2035	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 2036	4822 121 40366	15NF	10	1000	POLYESTER FOIL
C 2037	4822 122 31178	680PF	10	500	CERAMIC PLATE
C 2038	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 2039	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 2041	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 2042	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2043	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2044	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2049	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 2201	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2202	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2203	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2204	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2205	4822 124 20476	22UF	-10+50	25	ELECTROLYTIC
C 2301	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2302	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2303	4822 124 20474	3,3UF	-10+50	25	ELECTROLYTIC
C 2304	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2306	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2307	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2308	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2309	4822 124 20453	68UF	-10+50	6,3	ELECTROLYTIC
C 2311	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2401	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2402	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2403	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 2404	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 2406	4822 122 31072	47PF	2	100	CERAMIC PLATE
C 2407	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 2408	4822 122 31085	150PF	2	100	CERAMIC PLATE
C 2409	4822 122 31067	33PF	2	100	CERAMIC PLATE
C 2411	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2412	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2413	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2414	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2415	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2416	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2417	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2418	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2419	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2420	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2421	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2422	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2423	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2424	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2425	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2426	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2431	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2432	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2433	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2434	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2436	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2438	4822 124 20476	22UF	-10+50	25	ELECTROLYTIC
C 2439	4822 124 20476	22UF	-10+50	25	ELECTROLYTIC
C 2452	4822 124 20476	22UF	-10+50	25	ELECTROLYTIC
C 2454	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2600	4822 122 31081	100PF	2	100	CERAMIC PLATE

C 2621	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2622	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2623	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2624	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2626	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2627	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2651	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 2652	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2653	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2654	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2656	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2657	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2658	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2659	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2661	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2662	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2663	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2664	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2666	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2667	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2668	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2671	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 2672	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 2676	4822 122 31061	18PF	2	100	CERAMIC PLATE

Item	Ordering number	Ohm	Tol (%)	Type	Remarks
Resistors					
R 1	5322 101 44042	100K	20		CARBON POTM LIN + SWITCH
R 2	5322 102 44006	2X47K			CARBON TANDEM POTM + SWITCH
R 3	5322 101 44039	10K	20		CARBON POTM LIN + SWITCH
R 4	5322 101 44039	10K	20		CARBON POTM LIN + SWITCH
R 5	5322 101 44039	10K	20		CARBON POTM LIN + SWITCH
R 6	5322 101 24129	10K	20		CARBON POTM LIN
R 7	5322 101 44039	4K7	20	0,1W	CARBON POTM LIN + SWITCH
R 8	5322 101 44038	10K	20	0.1W	CARBON POTM LIN + SWITCH
R 9	5322 101 44038	10K	20	0.1W	CARBON POTM LIN + SWITCH
R 10	5322 101 44023	10K	20	0,1W	CARBON POTM LIN + SWITCH
R 11	5322 101 44023	10K	20	0,1W	CARBON POTM LIN + SWITCH
R 12	5322 101 24148	10K	20	0.1W	CARBON POTM LIN
R 13	5322 101 24148	10K	20	0.1W	CARBON POTM LIN
R 14	5322 101 44037	100K	20		CARBON POTM LIN + SWITCH
R 15	5322 101 24131	22K	20	0.1W	CARBON POTM LIN
R 16	5322 101 24132	10K	20	0.1W	CARBON POTM LIN
R 17	5322 101 24133	4,7M	20	0.1W	CARBON POTM LIN
R 18	5322 102 34019	2X47K	20	0,1W	CARBON TANDEM POTM
R 100	5322 116 50452	10	1	MR25	METAL FILM
R 101	5322 111 44121	1,8M	5	0,125W	CARBON
R 102	5322 116 64045	10	5	0.125W	METAL OXIDE
R 103	4822 116 51123	1K	5	0.125W	METAL FILM
R 104	5322 116 55152	900K	0,5	SPEC	METAL FILM
R 105	5322 116 64046	51	5	0.125W	METAL OXIDE
R 106	5322 116 55316	111K	0,5	MR25	METAL FILM
R 107	5322 116 64049	47	5	0.125W	METAL OXIDE
R 108	4822 116 51123	1K	5	0.125W	METAL FILM
R 109	5322 116 55153	992K	0,5	SPEC	METAL FILM
R 111	5322 116 55285	10,1K	0,5	MR25	METAL FILM
R 112	5322 116 64049	47	5	0.125W	METAL OXIDE
R 113	5322 116 64051	15	5	0.125W	METAL OXIDE
R 114	5322 111 30376	100M	5	0,125W	CARBON
R 116	5322 116 64051	15	5	0.125W	METAL OXIDE
R 117	5322 116 54442	51,1	1	MR25	METAL FILM
R 118	5322 116 54576	2,37K	1	MR25	METAL FILM
R 119	5322 116 50572	12,1K	1	MR25	METAL FILM
R 121	5322 116 54536	750	1	MR25	METAL FILM
R 122	5322 116 54335	750K	1	MR30	METAL FILM
R 123	5322 116 54735	255K	1	MR25	METAL FILM
R 124	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 126	5322 116 54038	221K	1	MR25	METAL FILM
R 127	4822 110 42214	10M	5	VR37	CARBON
R 128	4822 110 42227	33M	5	VR37	CARBON
R 129	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 131	5322 116 54595	5,11K	1	MR25	METAL FILM
R 132	5322 101 14056	47K	20	0.75W	TRIMMING POTM
R 133	5322 116 54696	100K	1	MR25	METAL FILM
R 134	5322 116 54743	301K	1	MR25	METAL FILM
R 141	5322 116 54504	274	1	MR25	METAL FILM
R 150	5322 116 50452	10	1	MR25	METAL FILM
R 151	5322 111 44121	1,8M	5	0,125W	CARBON
R 152	5322 116 64045	10	5	0.125W	METAL OXIDE
R 153	4822 116 51123	1K	5	0.125W	METAL FILM
R 154	5322 116 55152	900K	0,5	SPEC	METAL FILM
R 155	5322 116 64046	51	5	0.125W	METAL OXIDE
R 156	5322 116 55316	111K	0,5	MR25	METAL FILM
R 157	5322 116 64049	47	5	0.125W	METAL OXIDE
R 158	4822 116 51123	1K	5	0.125W	METAL FILM
R 159	5322 116 55153	992K	0,5	SPEC	METAL FILM
R 161	5322 116 55285	10,1K	0,5	MR25	METAL FILM
R 162	5322 116 64049	47	5	0.125W	METAL OXIDE
R 163	5322 116 64051	15	5	0.125W	METAL OXIDE
R 164	5322 111 30376	100M	5	0,125W	CARBON
R 166	5322 116 64051	15	5	0.125W	METAL OXIDE
R 167	5322 116 54442	51,1	1	MR25	METAL FILM
R 168	5322 116 54576	2,37K	1	MR25	METAL FILM
R 169	5322 116 50572	12,1K	1	MR25	METAL FILM
R 171	5322 116 54536	750	1	MR25	METAL FILM

R 172	5322 116 54335	750K	1	MR30	METAL FILM	
R 173	5322 116 54735	255K	1	MR25	METAL FILM	
R 174	5322 100 10143	1K	20	0.75W	TRIMMING POTM	
R 176	5322 116 54038	221K	1	MR25	METAL FILM	
R 177	4822 110 42214	10M	5	VR37	CARBON	
R 178	4822 110 42227	33M	5	VR37	CARBON	
R 179	5322 100 10141	10K	20	0.75W	TRIMMING POTM	
R 181	5322 116 54595	5,11K	1	MR25	METAL FILM	
R 182	5322 101 14056	47K	20	0.75W	TRIMMING POTM	
R 183	5322 116 54696	100K	1	MR25	METAL FILM	
R 184	5322 116 54743	301K	1	MR25	METAL FILM	
R 191	5322 116 54504	274	1	MR25	METAL FILM	
R 201	5322 116 50621	536	1	MR25	METAL FILM	
R 202	5322 116 50904	30,1	1	MR25	METAL FILM	
R 203	5322 116 54442	51,1	1	MR25	METAL FILM	
R 204	5322 116 50452	10	1	MR25	METAL FILM	
R 206	5322 116 50904	30,1	1	MR25	METAL FILM	
R 207	5322 116 54448	59	1	MR25	METAL FILM	
R 208	5322 116 64071	160	5	0.125W	METAL OXIDE	
R 209	5322 116 54549	1K	1	MR25	METAL FILM	
R 210	5322 116 50536	464	1	MR25	METAL FILM	
R 211	5322 116 54469	100	1	MR25	METAL FILM	
R 212	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 213	5322 116 50583	5,9K	1	MR25	METAL FILM	
R 214	5322 116 54469	100	1	MR25	METAL FILM	
R 215	5322 116 54469	100	1	MR25	METAL FILM	
R 216	5322 116 50608	6,19K	1	MR25	METAL FILM	
R 217	5322 116 50593	16,2K	1	MR25	METAL FILM	
R 218	5322 116 54511	316	1	MR25	METAL FILM	
R 219	5322 116 50636	2,74K	1	MR25	METAL FILM	
R 220	5322 116 64071	160	5	0.125W	METAL OXIDE	
R 221	5322 116 54469	100	1	MR25	METAL FILM	
R 222	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 223	5322 116 54619	10K	1	MR25	METAL FILM	
R 224	5322 116 54499	249	1	MR25	METAL FILM	
R 225	5322 116 54549	1K	1	MR25	METAL FILM	
R 226	5322 116 54469	100	1	MR25	METAL FILM	
R 227	5322 116 54499	249	1	MR25	METAL FILM	
R 228	5322 116 54446	56,2	1	MR25	METAL FILM	
R 229	5322 116 54455	68,1	1	MR25	METAL FILM	
R 230	5322 116 54469	100	1	MR25	METAL FILM	
R 231	5322 116 54497	226	1	MR25	METAL FILM	
R 232	5322 116 54469	100	1	MR25	METAL FILM	
R 233	5322 116 54455	68,1	1	MR25	METAL FILM	
R 234	5322 116 54497	226	1	MR25	METAL FILM	
R 235	5322 116 54597	5,36K	1	MR25	METAL FILM	
R 236	5322 116 54446	56,2	1	MR25	METAL FILM	
R 237	5322 116 54469	100	1	MR25	METAL FILM	
R 238	5322 116 50452	10	1	MR25	METAL FILM	
R 239	5322 116 50452	10	1	MR25	METAL FILM	
R 240	5322 116 54585	3,48K	1	MR25	METAL FILM	
R 241	5322 116 54696	100K	1	MR25	METAL FILM	
R 242	5322 116 54696	100K	1	MR25	METAL FILM	
R 246	5322 116 54585	3,48K	1	MR25	METAL FILM	
R 247	5322 116 50452	10	1	MR25	METAL FILM	
R 248	5322 116 50678	20,5	1	MR25	METAL FILM	
R 249	5322 116 54525	511	1	MR25	METAL FILM	
R 251	5322 116 50678	20,5	1	MR25	METAL FILM	
R 252	5322 116 50452	10	1	MR25	METAL FILM	
R 253	5322 100 10138	100	20	0.75W	TRIMMING POTM	
R 254	5322 100 10144	2,2K	20	0.75W	TRIMMING POTM	
R 255	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM	
R 257	5322 116 54469	100	1	MR25	METAL FILM	
R 258	5322 116 50583	5,9K	1	MR25	METAL FILM	
R 259	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 261	5322 116 50484	4,64K	1	MR25	METAL FILM	
R 262	5322 116 50484	4,64K	1	MR25	METAL FILM	
R 263	5322 116 54619	10K	1	MR25	METAL FILM	
R 264	5322 116 54469	100	1	MR25	METAL FILM	
R 266	5322 116 54469	100	1	MR25	METAL FILM	

R 267	5322 116 54595	5,11K	1	MR25	METAL FILM
R 268	5322 116 54595	5,11K	1	MR25	METAL FILM
R 269	5322 116 54469	100	1	MR25	METAL FILM
R 271	5322 116 54469	100	1	MR25	METAL FILM
R 272	5322 116 54597	5,36K	1	MR25	METAL FILM
R 273	5322 116 54469	100	1	MR25	METAL FILM
R 274	5322 116 54585	3,48K	1	MR25	METAL FILM
R 276	5322 116 54529	619	1	MR25	METAL FILM
R 277	5322 116 54532	649	1	MR25	METAL FILM
R 278	5322 116 54532	649	1	MR25	METAL FILM
R 279	5322 116 54469	100	1	MR25	METAL FILM
R 281	5322 116 54549	1K	1	MR25	METAL FILM
R 283	5322 116 54549	1K	1	MR25	METAL FILM
R 284	5322 116 54469	100	1	MR25	METAL FILM
R 289	5322 116 54469	100	1	MR25	METAL FILM
R 291	5322 116 50484	4,64K	1	MR25	METAL FILM
R 301	5322 116 50621	536	1	MR25	METAL FILM
R 302	5322 116 50904	30,1	1	MR25	METAL FILM
R 303	5322 116 54442	51,1	1	MR25	METAL FILM
R 304	5322 116 50452	10	1	MR25	METAL FILM
R 306	5322 116 50904	30,1	1	MR25	METAL FILM
R 307	5322 116 54448	59	1	MR25	METAL FILM
R 308	5322 116 64071	160	5	0.125W	METAL OXIDE
R 309	5322 116 54549	1K	1	MR25	METAL FILM
R 310	5322 116 50536	464	1	MR25	METAL FILM
R 311	5322 116 54469	100	1	MR25	METAL FILM
R 312	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 313	5322 116 50583	5,9K	1	MR25	METAL FILM
R 314	5322 116 54469	100	1	MR25	METAL FILM
R 315	5322 116 54469	100	1	MR25	METAL FILM
R 316	5322 116 50608	6,19K	1	MR25	METAL FILM
R 317	5322 116 50593	16,2K	1	MR25	METAL FILM
R 318	5322 116 54511	316	1	MR25	METAL FILM
R 319	5322 116 50636	2,74K	1	MR25	METAL FILM
R 320	5322 116 64071	160	5	0.125W	METAL OXIDE
R 321	5322 116 54469	100	1	MR25	METAL FILM
R 322	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 323	5322 116 54619	10K	1	MR25	METAL FILM
R 324	5322 116 54499	249	1	MR25	METAL FILM
R 325	5322 116 54549	1K	1	MR25	METAL FILM
R 326	5322 116 54469	100	1	MR25	METAL FILM
R 327	5322 116 54499	249	1	MR25	METAL FILM
R 328	5322 116 54446	56,2	1	MR25	METAL FILM
R 329	5322 116 54455	68,1	1	MR25	METAL FILM
R 330	5322 116 54469	100	1	MR25	METAL FILM
R 331	5322 116 54497	226	1	MR25	METAL FILM
R 332	5322 116 54469	100	1	MR25	METAL FILM
R 333	5322 116 54455	68,1	1	MR25	METAL FILM
R 334	5322 116 54497	226	1	MR25	METAL FILM
R 335	5322 116 54597	5,36K	1	MR25	METAL FILM
R 336	5322 116 54446	56,2	1	MR25	METAL FILM
R 337	5322 116 54469	100	1	MR25	METAL FILM
R 338	5322 116 50452	10	1	MR25	METAL FILM
R 339	5322 116 50452	10	1	MR25	METAL FILM
R 340	5322 116 54585	3,48K	1	MR25	METAL FILM
R 341	5322 116 54696	100K	1	MR25	METAL FILM
R 342	5322 116 54696	100K	1	MR25	METAL FILM
R 346	5322 116 54585	3,48K	1	MR25	METAL FILM
R 347	5322 116 50452	10	1	MR25	METAL FILM
R 348	5322 116 50678	20,5	1	MR25	METAL FILM
R 349	5322 116 54525	511	1	MR25	METAL FILM
R 351	5322 116 50678	20,5	1	MR25	METAL FILM
R 352	5322 116 50452	10	1	MR25	METAL FILM
R 357	5322 116 54469	100	1	MR25	METAL FILM
R 358	5322 116 50583	5,9K	1	MR25	METAL FILM
R 359	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 361	5322 116 50484	4,64K	1	MR25	METAL FILM
R 362	5322 116 50484	4,64K	1	MR25	METAL FILM
R 363	5322 116 54619	10K	1	MR25	METAL FILM
R 364	5322 116 54469	100	1	MR25	METAL FILM

R 366	5322 116 54469	100	1	MR25	METAL FILM
R 367	5322 116 54595	5,11K	1	MR25	METAL FILM
R 368	5322 116 54595	5,11K	1	MR25	METAL FILM
R 369	5322 116 54469	100	1	MR25	METAL FILM
R 371	5322 116 54469	100	1	MR25	METAL FILM
R 372	5322 116 54597	5,36K	1	MR25	METAL FILM
R 373	5322 116 54469	100	1	MR25	METAL FILM
R 374	5322 116 54585	3,48K	1	MR25	METAL FILM
R 376	5322 116 54529	619	1	MR25	METAL FILM
R 377	5322 116 54532	649	1	MR25	METAL FILM
R 378	5322 116 54532	649	1	MR25	METAL FILM
R 379	5322 116 54469	100	1	MR25	METAL FILM
R 381	5322 116 54549	1K	1	MR25	METAL FILM
R 383	5322 116 54549	1K	1	MR25	METAL FILM
R 384	5322 116 54469	100	1	MR25	METAL FILM
R 389	5322 116 54469	100	1	MR25	METAL FILM
R 391	5322 116 50484	4,64K	1	MR25	METAL FILM
R 401	5322 116 54442	51,1	1	MR25	METAL FILM
R 402	5322 116 54516	365	1	MR25	METAL FILM
R 403	5322 116 50452	10	1	MR25	METAL FILM
R 404	5322 116 54585	3,48K	1	MR25	METAL FILM
R 405	5322 116 54469	100	1	MR25	METAL FILM
R 406	5322 116 54585	3,48K	1	MR25	METAL FILM
R 407	5322 116 54469	100	1	MR25	METAL FILM
R 408	5322 116 54499	249	1	MR25	METAL FILM
R 409	5322 116 50861	15,8	1	MR25	METAL FILM
R 411	5322 116 50568	4,99	1	MR25	METAL FILM
R 412	5322 116 50861	15,8	1	MR25	METAL FILM
R 413	5322 116 50568	4,99	1	MR25	METAL FILM
R 414	5322 116 50452	10	1	MR25	METAL FILM
R 415	5322 116 54549	1K	1	MR25	METAL FILM
R 416	5322 116 54516	365	1	MR25	METAL FILM
R 417	5322 116 54492	178	1	MR25	METAL FILM
R 418	5322 116 54696	100K	1	MR25	METAL FILM
R 419	5322 116 54469	100	1	MR25	METAL FILM
R 420	5322 116 54536	750	1	MR25	METAL FILM
R 421	5322 116 50583	5,9K	1	MR25	METAL FILM
R 422	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 423	5322 116 54469	100	1	MR25	METAL FILM
R 424	5322 116 50583	5,9K	1	MR25	METAL FILM
R 426	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 427	5322 116 50671	2,61K	1	MR25	METAL FILM
R 428	5322 116 54499	249	1	MR25	METAL FILM
R 429	5322 116 54558	8,25K	1	MR25	METAL FILM
R 431	5322 116 50572	12,1K	1	MR25	METAL FILM
R 433	5322 116 50664	2,05K	1	MR25	METAL FILM
R 434	5322 116 54619	10K	1	MR25	METAL FILM
R 436	5322 116 50671	2,61K	1	MR25	METAL FILM
R 451	5322 116 54442	51,1	1	MR25	METAL FILM
R 452	5322 116 54516	365	1	MR25	METAL FILM
R 453	5322 116 50452	10	1	MR25	METAL FILM
R 454	5322 116 54585	3,48K	1	MR25	METAL FILM
R 455	5322 116 54469	100	1	MR25	METAL FILM
R 456	5322 116 54585	3,48K	1	MR25	METAL FILM
R 457	5322 116 54469	100	1	MR25	METAL FILM
R 458	5322 116 54499	249	1	MR25	METAL FILM
R 459	5322 116 50861	15,8	1	MR25	METAL FILM
R 461	5322 116 50568	4,99	1	MR25	METAL FILM
R 462	5322 116 50861	15,8	1	MR25	METAL FILM
R 463	5322 116 50568	4,99	1	MR25	METAL FILM
R 464	5322 116 50452	10	1	MR25	METAL FILM
R 465	5322 116 54549	1K	1	MR25	METAL FILM
R 466	5322 116 54516	365	1	MR25	METAL FILM
R 467	5322 116 54492	178	1	MR25	METAL FILM
R 468	5322 116 54696	100K	1	MR25	METAL FILM
R 469	5322 116 54469	100	1	MR25	METAL FILM
R 470	5322 116 54536	750	1	MR25	METAL FILM
R 471	5322 116 50583	5,9K	1	MR25	METAL FILM
R 472	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 473	5322 116 54469	100	1	MR25	METAL FILM

R 474	5322 116 50583	5,9K	1	MR25	METAL FILM	
R 476	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 477	5322 116 50671	2,61K	1	MR25	METAL FILM	
R 478	5322 116 54499	249	1	MR25	METAL FILM	
R 479	5322 116 54558	8,25K	1	MR25	METAL FILM	
R 482	5322 116 50479	15,4K	1	MR25	METAL FILM	
R 484	5322 116 54619	10K	1	MR25	METAL FILM	
R 486	5322 116 50671	2,61K	1	MR25	METAL FILM	
R 487	5322 116 54469	100	1	MR25	METAL FILM	
R 488	5322 116 50484	4,64K	1	MR25	METAL FILM	
R 489	5322 116 50479	15,4K	1	MR25	METAL FILM	
R 501	5322 116 54455	68,1	1	MR25	METAL FILM	
R 502	5322 116 54484	140	1	MR25	METAL FILM	
R 503	5322 116 50511	48,7	1	MR25	METAL FILM	
R 504	5322 116 54504	274	1	MR25	METAL FILM	
R 506	5322 116 54499	249	1	MR25	METAL FILM	
R 507	5322 116 54455	68,1	1	MR25	METAL FILM	
R 508	5322 116 54484	140	1	MR25	METAL FILM	
R 509	5322 116 54519	402	1	MR25	METAL FILM	
R 511	5322 116 54442	51,1	1	MR25	METAL FILM	
R 512	5322 116 50511	48,7	1	MR25	METAL FILM	
R 513	5322 116 54504	274	1	MR25	METAL FILM	
R 514	5322 116 54499	249	1	MR25	METAL FILM	
R 516	5322 116 54448	59	1	MR25	METAL FILM	
R 517	5322 116 50524	3,01K	1	MR25	METAL FILM	
R 518	5322 116 50636	2,74K	1	MR25	METAL FILM	
R 519	5322 116 54469	100	1	MR25	METAL FILM	
R 521	5322 116 50621	536	1	MR25	METAL FILM	
R 522	5322 116 54504	274	1	MR25	METAL FILM	
R 523	5322 116 50621	536	1	MR25	METAL FILM	
R 524	5322 116 54448	59	1	MR25	METAL FILM	
R 526	5322 116 50583	5,9K	1	MR25	METAL FILM	
R 527	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 528	5322 116 54469	100	1	MR25	METAL FILM	
R 529	5322 116 50621	536	1	MR25	METAL FILM	
R 531	5322 116 50452	10	1	MR25	METAL FILM	
R 534	5322 116 50904	30,1	1	MR25	METAL FILM	
R 536	5322 116 54534	681	1	MR25	METAL FILM	
R 537	5322 116 50904	30,1	1	MR25	METAL FILM	
R 539	5322 116 54549	1K	1	MR25	METAL FILM	
R 542	5322 116 50452	10	1	MR25	METAL FILM	
R 543	5322 116 54469	100	1	MR25	METAL FILM	
R 544	5322 116 50621	536	1	MR25	METAL FILM	
R 546	5322 116 50484	4,64K	1	MR25	METAL FILM	
R 547	5322 116 54469	100	1	MR25	METAL FILM	
R 552	5322 116 54426	121	1	MR25	METAL FILM	
R 601	5322 116 50571	715	1	MR25	METAL FILM	
R 602	5322 116 54442	51,1	1	MR25	METAL FILM	
R 603	5322 116 50669	205	1	MR25	METAL FILM	
R 604	5322 116 54448	59	1	MR25	METAL FILM	
R 605	5322 116 54448	59	1	MR25	METAL FILM	
R 606	5322 116 50729	4,22K	1	MR25	METAL FILM	
R 607	5322 116 54469	100	1	MR25	METAL FILM	
R 608	5322 116 50675	2,26K	1	MR25	METAL FILM	
R 609	5322 116 54442	51,1	1	MR25	METAL FILM	
R 611	5322 116 50571	715	1	MR25	METAL FILM	
R 612	5322 116 50669	205	1	MR25	METAL FILM	
R 613	5322 116 54448	59	1	MR25	METAL FILM	
R 614	5322 116 54012	6,81K	1	MR25	METAL FILM	
R 615	5322 116 54448	59	1	MR25	METAL FILM	
R 616	5322 116 50484	4,64K	1	MR25	METAL FILM	
R 617	5322 116 54515	348	1	MR25	METAL FILM	
R 618	5322 116 54484	140	1	MR25	METAL FILM	
R 619	5322 116 54558	8,25K	1	MR25	METAL FILM	
R 621	5322 116 54469	100	1	MR25	METAL FILM	
R 622	5322 116 54562	1,4K	1	MR25	METAL FILM	
R 623	5322 116 54462	82,5	1	MR25	METAL FILM	
R 624	5322 116 54484	140	1	MR25	METAL FILM	
R 626	5322 116 54515	348	1	MR25	METAL FILM	
R 627	5322 116 50484	4,64K	1	MR25	METAL FILM	

R 628	5322 116 54012	6,81K	1	MR25	METAL FILM	
R 629	5322 116 54549	1K	1	MR25	METAL FILM	
R 631	5322 116 54511	316	1	MR25	METAL FILM	
R 632	5322 116 50636	2,74K	1	MR25	METAL FILM	
R 634	5322 101 14066	10K	20	0.5W	TRIMMING POTM	
R 636	5322 101 14067	4,7K	20	0.5W	TRIMMING POTM	
R 637	5322 116 54469	100	1	MR25	METAL FILM	
R 639	5322 116 50452	10	1	MR25	METAL FILM	
R 640	5322 116 54619	10K	1	MR25	METAL FILM	
R 641	5322 116 50452	10	1	MR25	METAL FILM	
R 642	5322 116 54619	10K	1	MR25	METAL FILM	
R 643	5322 116 50678	20,5	1	MR25	METAL FILM	
R 644	5322 116 50678	20,5	1	MR25	METAL FILM	
R 646	5322 101 14066	10K	20	0.5W	TRIMMING POTM	
R 647	5322 116 50636	2,74K	1	MR25	METAL FILM	
R 649	4822 116 30018	1,3K	10	1W	NTC	
R 652	5322 116 50672	51,1K	1	MR25	METAL FILM	
R 653	5322 116 54648	24,9K	1	MR25	METAL FILM	
R 654	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 655	5322 116 50664	2,05K	1	MR25	METAL FILM	
R 656	5322 116 50664	2,05K	1	MR25	METAL FILM	
R 657	5322 116 54469	100	1	MR25	METAL FILM	
R 658	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 659	5322 116 50766	147	1	MR25	METAL FILM	
R 660	5322 116 50766	147	1	MR25	METAL FILM	
R 661	5322 116 54469	100	1	MR25	METAL FILM	
R 701	5322 116 54442	51,1	1	MR25	METAL FILM	
R 702	5322 116 54408	909K	1	MR30	METAL FILM	
R 703	5322 116 54701	110K	1	MR25	METAL FILM	
R 704	5322 116 54508	301	1	MR25	METAL FILM	
R 706	5322 116 54335	750K	1	MR30	METAL FILM	
R 707	5322 116 54549	1K	1	MR25	METAL FILM	
R 708	5322 116 54549	1K	1	MR25	METAL FILM	
R 709	5322 116 54734	249K	1	MR25	METAL FILM	
R 711	4822 110 63214	10M	10	CR25	CARBON	
R 712	5322 116 50527	33,2	1	MR25	METAL FILM	
R 713	5322 116 54012	6,81K	1	MR25	METAL FILM	
R 714	5322 116 54648	24,9K	1	MR25	METAL FILM	
R 716	5322 116 50572	12,1K	1	MR25	METAL FILM	
R 717	5322 116 54696	100K	1	MR25	METAL FILM	
R 718	5322 116 54648	24,9K	1	MR25	METAL FILM	
R 719	5322 116 54012	6,81K	1	MR25	METAL FILM	
R 721	5322 116 50572	12,1K	1	MR25	METAL FILM	
R 722	5322 116 54648	24,9K	1	MR25	METAL FILM	
R 723	5322 116 54012	6,81K	1	MR25	METAL FILM	
R 724	5322 116 54547	953	1	MR25	METAL FILM	
R 726	5322 116 54469	100	1	MR25	METAL FILM	
R 727	5322 116 54557	1,21K	1	MR25	METAL FILM	
R 728	5322 116 54595	5,11K	1	MR25	METAL FILM	
R 729	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 730	5322 116 54525	511	1	MR25	METAL FILM	
R 731	5322 116 54723	187K	1	MR25	METAL FILM	
R 732	5322 116 54605	6,98K	1	MR25	METAL FILM	
R 733	5322 116 50581	2,49K	1	MR25	METAL FILM	
R 734	5322 116 54685	71,5K	1	MR25	METAL FILM	
R 735	5322 116 54595	5,11K	1	MR25	METAL FILM	
R 736	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 741	5322 116 54529	619	1	MR25	METAL FILM	
R 742	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 900	5322 116 54567	1,69K	1	MR25	METAL FILM	
R 901	5322 116 50664	2,05K	1	MR25	METAL FILM	
R 902	5322 116 54549	1K	1	MR25	METAL FILM	
R 903	5322 116 50561	590	1	MR25	METAL FILM	
R 904	5322 116 50527	33,2	1	MR25	METAL FILM	
R 905	5322 116 54508	301	1	MR25	METAL FILM	
R 906	5322 116 50536	464	1	MR25	METAL FILM	
R 907	5322 116 50536	464	1	MR25	METAL FILM	
R 908	5322 116 50675	2,26K	1	MR25	METAL FILM	
R 909	5322 116 50675	2,26K	1	MR25	METAL FILM	
R 910	5322 116 54606	7,15K	1	MR25	METAL FILM	

R 911	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 912	5322 116 54595	5,11K	1	MR25	METAL FILM	
R 913	5322 100 10113	10K	20	0,5W	TRIMMING POTM	
R 914	5322 116 54536	750	1	MR25	METAL FILM	
R 916	5322 116 50581	2,49K	1	MR25	METAL FILM	
R 917	5322 116 54619	10K	1	MR25	METAL FILM	
R 918	5322 116 54589	3,83K	1	MR25	METAL FILM	
R 919	5322 116 50527	33,2	1	MR25	METAL FILM	
R 920	5322 116 54508	301	1	MR25	METAL FILM	
R 921	5322 116 50572	12,1K	1	MR25	METAL FILM	
R 922	5322 116 50583	5,9K	1	MR25	METAL FILM	
R 923	5322 116 50527	33,2	1	MR25	METAL FILM	
R 924	5322 116 50527	33,2	1	MR25	METAL FILM	
R 926	5322 116 54249	487	0,25	MR24C	METAL FILM	
R 927	5322 116 50481	22,6K	1	MR25	METAL FILM	
R 928	5322 116 54549	1K	1	MR25	METAL FILM	
R 929	5322 116 50481	22,6K	1	MR25	METAL FILM	
R 931	5322 116 54549	1K	1	MR25	METAL FILM	
R 932	5322 116 50481	22,6K	1	MR25	METAL FILM	
R 933	5322 116 54549	1K	1	MR25	METAL FILM	
R 934	5322 116 50483	38,3K	1	MR25	METAL FILM	
R 936	5322 116 54619	10K	1	MR25	METAL FILM	
R 937	5322 116 54619	10K	1	MR25	METAL FILM	
R 938	4822 110 63207	5,6M	10	CR25	CARBON	
R 939	5322 116 54619	10K	1	MR25	METAL FILM	
R 940	5322 116 54513	332	1	MR25	METAL FILM	
R 941	5322 116 54192	5,11	1	MR25	METAL FILM	
R 942	5322 116 50664	2,05K	1	MR25	METAL FILM	
R 943	5322 116 54455	68,1	1	MR25	METAL FILM	
R 944	5322 116 50482	33,2K	1	MR25	METAL FILM	
R 945	5322 116 50527	33,2	1	MR25	METAL FILM	
R 946	5322 116 50581	2,49K	1	MR25	METAL FILM	
R 947	5322 116 50664	2,05K	1	MR25	METAL FILM	
R 948	5322 116 50728	1,87K	1	MR25	METAL FILM	
R 949	5322 116 54466	90,9	1	MR25	METAL FILM	
R 950	5322 116 54525	511	1	MR25	METAL FILM	
R 951	5322 116 54442	51,1	1	MR25	METAL FILM	
R 952	5322 116 54504	274	1	MR25	METAL FILM	
R 953	5322 116 54469	100	1	MR25	METAL FILM	
R 954	5322 116 54504	274	1	MR25	METAL FILM	
R 955	5322 116 54442	51,1	1	MR25	METAL FILM	
R 956	5322 116 54536	750	1	MR25	METAL FILM	
R 957	5322 116 50491	22,6	1	MR25	METAL FILM	
R 958	5322 116 54536	750	1	MR25	METAL FILM	
R 959	5322 116 54005	3,32K	1	MR25	METAL FILM	
R 960	5322 116 54558	8,25K	1	MR25	METAL FILM	
R 961	5322 116 54619	10K	1	MR25	METAL FILM	
R 962	5322 116 54549	1K	1	MR25	METAL FILM	
R 963	5322 116 50669	205	1	MR25	METAL FILM	
R 964	5322 116 50481	22,6K	1	MR25	METAL FILM	
R 965	5322 116 50482	33,2K	1	MR25	METAL FILM	
R 966	5322 116 54009	562	1	MR25	METAL FILM	
R 967	5322 116 54504	274	1	MR25	METAL FILM	
R 968	5322 116 54504	274	1	MR25	METAL FILM	
R 969	5322 116 54469	100	1	MR25	METAL FILM	
R 970	5322 116 54619	10K	1	MR25	METAL FILM	
R 971	5322 116 50635	1,47K	1	MR25	METAL FILM	
R 972	5322 116 54619	10K	1	MR25	METAL FILM	
R 973	5322 116 50536	464	1	MR25	METAL FILM	
R 974	5322 116 50593	16,2K	1	MR25	METAL FILM	
R 975	5322 116 54469	100	1	MR25	METAL FILM	
R 976	5322 116 50482	33,2K	1	MR25	METAL FILM	
R 977	5322 116 50479	15,4K	1	MR25	METAL FILM	
R 978	5322 116 50635	1,47K	1	MR25	METAL FILM	
R 979	5322 116 54549	1K	1	MR25	METAL FILM	
R 980	5322 116 54589	3,83K	1	MR25	METAL FILM	
R 981	5322 116 54549	1K	1	MR25	METAL FILM	
R 982	5322 116 54549	1K	1	MR25	METAL FILM	
R 983	5322 116 50481	22,6K	1	MR25	METAL FILM	
R 984	5322 116 54519	402	1	MR25	METAL FILM	

R 985	5322 116 55315	619K	1	MR25	METAL FILM
R 986	5322 116 50527	33,2	1	MR25	METAL FILM
R 987	5322 116 50482	33,2K	1	MR25	METAL FILM
R 992	5322 116 50555	1,27K	1	MR25	METAL FILM
R 993	5322 116 54549	1K	1	MR25	METAL FILM
R 994	5322 116 50767	2,15K	1	MR25	METAL FILM
R 995	5322 116 54508	301	1	MR25	METAL FILM
R 996	5322 116 54508	301	1	MR25	METAL FILM
R 997	5322 116 54442	51,1	1	MR25	METAL FILM
R 998	5322 116 54619	10K	1	MR25	METAL FILM
R 1001	5322 116 54877	402	0,25	MR24C	METAL FILM
R 1002	5322 116 54902	876K	0,25	MR54C	METAL FILM
R 1003	5322 116 54901	887K	0,25	MR54C	METAL FILM
R 1004	5322 116 54896	354K	0,25	MR34C	METAL FILM
R 1006	5322 116 54899	176K	0,25	MR34C	METAL FILM
R 1007	5322 116 54897	87,6K	0,25	MR24C	METAL FILM
R 1008	5322 116 54895	34,6K	0,25	MR24C	METAL FILM
R 1009	5322 116 54894	16,8K	0,25	MR24C	METAL FILM
R 1011	5322 116 55161	7,96K	0,25	MR24C	METAL FILM
R 1012	5322 116 50784	2,67K	0,25	MR24C	METAL FILM
R 1013	5322 116 54898	887	0,25	MR24C	METAL FILM
R 1014	5322 116 54504	274	1	MR25	METAL FILM
R 1101	5322 116 50527	33,2	1	MR25	METAL FILM
R 1102	5322 116 54335	750K	1	MR30	METAL FILM
R 1103	5322 116 54549	1K	1	MR25	METAL FILM
R 1104	5322 116 54549	1K	1	MR25	METAL FILM
R 1106	5322 116 54734	249K	1	MR25	METAL FILM
R 1107	4822 110 63214	10M	10	CR25	CARBON
R 1108	5322 116 50581	2,49K	1	MR25	METAL FILM
R 1109	5322 116 50527	33,2	1	MR25	METAL FILM
R 1111	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1112	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1113	5322 116 54552	1,05K	1	MR25	METAL FILM
R 1114	5322 116 54723	187K	1	MR25	METAL FILM
R 1116	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1117	5322 116 54685	71,5K	1	MR25	METAL FILM
R 1118	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1251	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1300	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1301	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1303	5322 116 54536	750	1	MR25	METAL FILM
R 1304	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1305	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1306	5322 116 54504	274	1	MR25	METAL FILM
R 1307	5322 116 54504	274	1	MR25	METAL FILM
R 1308	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1309	5322 116 50536	464	1	MR25	METAL FILM
R 1310	5322 116 54619	10K	1	MR25	METAL FILM
R 1311	5322 116 54469	100	1	MR25	METAL FILM
R 1312	5322 116 50536	464	1	MR25	METAL FILM
R 1313	5322 116 54549	1K	1	MR25	METAL FILM
R 1314	5322 116 50527	33,2	1	MR25	METAL FILM
R 1317	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1318	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1319	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1320	5322 116 54619	10K	1	MR25	METAL FILM
R 1321	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1322	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1323	5322 116 54536	750	1	MR25	METAL FILM
R 1324	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1326	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1327	5322 116 54589	3,83K	1	MR25	METAL FILM
R 1328	5322 116 54619	10K	1	MR25	METAL FILM
R 1329	5322 116 50527	33,2	1	MR25	METAL FILM
R 1331	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1332	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1333	5322 116 50527	33,2	1	MR25	METAL FILM
R 1334	5322 116 50527	33,2	1	MR25	METAL FILM
R 1335	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1336	5322 116 54898	887	0,25	MR24C	METAL FILM

R 1337	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1338	5322 116 54549	1K	1	MR25	METAL FILM
R 1339	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1341	5322 116 54549	1K	1	MR25	METAL FILM
R 1342	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1343	5322 116 54549	1K	1	MR25	METAL FILM
R 1344	5322 116 50954	38,3	1	MR25	METAL FILM
R 1346	5322 116 54619	10K	1	MR25	METAL FILM
R 1347	5322 116 54455	68,1	1	MR25	METAL FILM
R 1348	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1349	5322 116 50581	2,49K	1	MR25	METAL FILM
R 1350	5322 116 54513	332	1	MR25	METAL FILM
R 1351	4822 110 63207	5,6M	10	CR25	CARBON
R 1352	5322 116 54442	51,1	1	MR25	METAL FILM
R 1353	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1354	5322 116 54619	10K	1	MR25	METAL FILM
R 1355	5322 116 50527	33,2	1	MR25	METAL FILM
R 1356	5322 116 54619	10K	1	MR25	METAL FILM
R 1357	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1358	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1359	5322 116 54504	274	1	MR25	METAL FILM
R 1360	5322 116 50555	1,27K	1	MR25	METAL FILM
R 1361	5322 116 54504	274	1	MR25	METAL FILM
R 1362	5322 116 54536	750	1	MR25	METAL FILM
R 1363	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1364	5322 116 54469	100	1	MR25	METAL FILM
R 1365	5322 116 54549	1K	1	MR25	METAL FILM
R 1366	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1367	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1368	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1369	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1370	5322 116 54549	1K	1	MR25	METAL FILM
R 1371	5322 116 54469	100	1	MR25	METAL FILM
R 1372	5322 116 54469	100	1	MR25	METAL FILM
R 1373	5322 116 50527	33,2	1	MR25	METAL FILM
R 1374	5322 116 50527	33,2	1	MR25	METAL FILM
R 1386	5322 116 54508	301	1	MR25	METAL FILM
R 1387	5322 116 50561	590	1	MR25	METAL FILM
R 1388	5322 116 54508	301	1	MR25	METAL FILM
R 1389	5322 116 54545	909	1	MR25	METAL FILM
R 1391	5322 116 54545	909	1	MR25	METAL FILM
R 1392	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1393	5322 116 54536	750	1	MR25	METAL FILM
R 1394	5322 116 54549	1K	1	MR25	METAL FILM
R 1396	5322 116 54508	301	1	MR25	METAL FILM
R 1397	5322 116 54508	301	1	MR25	METAL FILM
R 1398	5322 116 50767	2,15K	1	MR25	METAL FILM
R 1401	5322 116 54901	887K	0,25	MR54C	METAL FILM
R 1402	5322 116 54896	354K	0,25	MR34C	METAL FILM
R 1403	5322 116 54899	176K	0,25	MR34C	METAL FILM
R 1404	5322 116 54897	87,6K	0,25	MR24C	METAL FILM
R 1406	5322 116 54895	34,6K	0,25	MR24C	METAL FILM
R 1407	5322 116 54894	16,8K	0,25	MR24C	METAL FILM
R 1408	5322 116 55161	7,96K	0,25	MR24C	METAL FILM
R 1409	5322 116 50784	2,67K	0,25	MR24C	METAL FILM
R 1411	5322 116 54898	887	0,25	MR24C	METAL FILM
R 1501	5322 116 54549	1K	1	MR25	METAL FILM
R 1502	5322 116 54619	10K	1	MR25	METAL FILM
R 1503	5322 116 50527	33,2	1	MR25	METAL FILM
R 1504	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1506	5322 116 54619	10K	1	MR25	METAL FILM
R 1507	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1508	5322 116 54519	402	1	MR25	METAL FILM
R 1509	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1511	5322 116 54519	402	1	MR25	METAL FILM
R 1512	5322 116 54549	1K	1	MR25	METAL FILM
R 1513	5322 116 54549	1K	1	MR25	METAL FILM
R 1514	5322 116 54619	10K	1	MR25	METAL FILM
R 1515	5322 116 50536	464	1	MR25	METAL FILM
R 1516	5322 116 54619	10K	1	MR25	METAL FILM

R 1517	5322 116 50527	33,2	1	MR25	METAL FILM
R 1518	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1519	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1520	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1521	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1522	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1524	5322 116 54613	8,66K	1	MR25	METAL FILM
R 1525	5322 116 50492	46,4	1	MR25	METAL FILM
R 1526	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1527	5322 116 50527	33,2	1	MR25	METAL FILM
R 1528	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1529	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1531	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1532	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1533	5322 116 54619	10K	1	MR25	METAL FILM
R 1534	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1535	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1536	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1537	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1538	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1539	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1541	5322 116 54469	100	1	MR25	METAL FILM
R 1542	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1543	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1551	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1552	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1553	5322 116 54585	3,48K	1	MR25	METAL FILM
R 1554	5322 116 54513	332	1	MR25	METAL FILM
R 1556	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1557	5322 116 54513	332	1	MR25	METAL FILM
R 1558	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1559	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1561	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1562	5322 116 54513	332	1	MR25	METAL FILM
R 1563	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1564	5322 116 50578	78,7	1	MR25	METAL FILM
R 1566	5322 116 54513	332	1	MR25	METAL FILM
R 1567	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1568	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1569	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1570	5322 116 54469	100	1	MR25	METAL FILM
R 1571	5322 116 54513	332	1	MR25	METAL FILM
R 1572	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1573	5322 116 50669	205	1	MR25	METAL FILM
R 1574	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1576	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1577	5322 116 54513	332	1	MR25	METAL FILM
R 1578	5322 116 50578	78,7	1	MR25	METAL FILM
R 1579	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1581	5322 116 54513	332	1	MR25	METAL FILM
R 1601	5322 116 54534	681	1	MR25	METAL FILM
R 1602	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1603	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1604	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1606	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1607	5322 116 54549	1K	1	MR25	METAL FILM
R 1608	5322 116 54637	17,8K	1	MR25	METAL FILM
R 1609	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1611	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1612	5322 116 54549	1K	1	MR25	METAL FILM
R 1613	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1614	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1616	5322 116 54513	332	1	MR25	METAL FILM
R 1617	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1618	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1619	5322 116 54549	1K	1	MR25	METAL FILM
R 1621	5322 116 54549	1K	1	MR25	METAL FILM
R 1622	5322 116 54469	100	1	MR25	METAL FILM
R 1623	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1624	5322 116 54562	1,4K	1	MR25	METAL FILM

R 1626	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1627	5322 116 54469	100	1	MR25	METAL FILM
R 1628	5322 116 54469	100	1	MR25	METAL FILM
R 1629	5322 116 54469	100	1	MR25	METAL FILM
R 1631	5322 116 54469	100	1	MR25	METAL FILM
R 1632	5322 116 54469	100	1	MR25	METAL FILM
R 1633	5322 116 54469	100	1	MR25	METAL FILM
R 1651	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1652	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1653	5322 116 54585	3,48K	1	MR25	METAL FILM
R 1654	5322 116 54513	332	1	MR25	METAL FILM
R 1656	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1657	5322 116 54513	332	1	MR25	METAL FILM
R 1658	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1659	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1660	5322 116 50492	46,4	1	MR25	METAL FILM
R 1661	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1662	5322 116 54513	332	1	MR25	METAL FILM
R 1663	5322 116 54513	332	1	MR25	METAL FILM
R 1664	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1666	5322 116 51052	42,2	1	MR25	METAL FILM
R 1667	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1668	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1669	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1671	5322 116 54513	332	1	MR25	METAL FILM
R 1672	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1673	5322 116 54484	140	1	MR25	METAL FILM
R 1674	5322 116 51052	42,2	1	MR25	METAL FILM
R 1675	5322 116 50492	46,4	1	MR25	METAL FILM
R 1676	5322 116 54484	140	1	MR25	METAL FILM
R 1677	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1678	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1679	5322 116 54513	332	1	MR25	METAL FILM
R 1681	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1682	5322 116 50492	46,4	1	MR25	METAL FILM
R 1683	5322 116 50492	46,4	1	MR25	METAL FILM
R 1701	5322 116 54525	511	1	MR25	METAL FILM
R 1702	5322 116 50561	590	1	MR25	METAL FILM
R 1703	5322 116 50527	33,2	1	MR25	METAL FILM
R 1704	5322 116 50417	162	1	MR25	METAL FILM
R 1706	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 1707	5322 116 54474	110	1	MR25	METAL FILM
R 1708	5322 116 50581	2,49K	1	MR25	METAL FILM
R 1709	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1710	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1711	5322 116 50732	549	1	MR25	METAL FILM
R 1712	5322 116 50732	549	1	MR25	METAL FILM
R 1713	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1714	5322 116 54619	10K	1	MR25	METAL FILM
R 1716	5322 116 50592	442	1	MR25	METAL FILM
R 1718	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1719	5322 116 50491	22,6	1	MR25	METAL FILM
R 1721	5322 116 50527	33,2	1	MR25	METAL FILM
R 1722	5322 116 54701	110K	1	MR25	METAL FILM
R 1723	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1724	5322 116 54696	100K	1	MR25	METAL FILM
R 1726	5322 116 54641	19,6K	1	MR25	METAL FILM
R 1727	5322 116 50671	2,61K	1	MR25	METAL FILM
R 1728	5322 116 54532	649	1	MR25	METAL FILM
R 1729	5322 116 54462	82,5	1	MR25	METAL FILM
R 1731	5322 116 54619	10K	1	MR25	METAL FILM
R 1732	5322 116 54525	511	1	MR25	METAL FILM
R 1733	5322 116 54549	1K	1	MR25	METAL FILM
R 1734	5322 116 54519	402	1	MR25	METAL FILM
R 1736	5322 116 54723	187K	1	MR25	METAL FILM
R 1737	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 1738	5322 116 54549	1K	1	MR25	METAL FILM
R 1739	5322 116 54519	402	1	MR25	METAL FILM
R 1741	5322 116 54723	187K	1	MR25	METAL FILM
R 1742	5322 116 54525	511	1	MR25	METAL FILM

R 1743	5322 116 54462	82,5	1	MR25	METAL FILM
R 1744	5322 116 54619	10K	1	MR25	METAL FILM
R 1746	5322 116 54606	7,15K	1	MR25	METAL FILM
R 1747	5322 116 54532	649	1	MR25	METAL FILM
R 1748	5322 116 54619	10K	1	MR25	METAL FILM
R 1749	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1801	5322 116 54743	301K	1	MR25	METAL FILM
R 1802	5322 116 54743	301K	1	MR25	METAL FILM
R 1803	4822 110 42187	1M	5	VR37	CARBON
R 1804	4822 112 21121	3,3K	5	4.2W	WIRE-WOUND
R 1806	5322 116 44006				PTC
R 1807	5322 116 54701	110K	1	MR25	METAL FILM
R 1808	5322 116 54701	110K	1	MR25	METAL FILM
R 1809	5322 116 54701	110K	1	MR25	METAL FILM
R 1811	4822 110 63029	1,2	5	CR25	CARBON
R 1812	5322 116 54469	100	1	MR25	METAL FILM
R 1813	5322 116 50491	22,6	1	MR25	METAL FILM
R 1814	5322 116 54351	20	5	PR52	METAL FILM
R 1816	5322 116 55205	2K	5	PR52	METAL FILM
R 1817	4822 110 63214	10M	10	CR25	CARBON
R 1818	4822 110 63214	10M	10	CR25	CARBON
R 1819	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1821	5322 116 50483	38,3K	1	MR25	METAL FILM
R 1822	5322 116 54571	1,96K	1	MR25	METAL FILM
R 1823	5322 116 54696	100K	1	MR25	METAL FILM
R 1824	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1826	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 1827	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1828	5322 116 50593	16,2K	1	MR25	METAL FILM
R 1829	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1831	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1832	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1833	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1834	5322 116 54499	249	1	MR25	METAL FILM
R 1836	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1837	5322 116 54499	249	1	MR25	METAL FILM
R 1838	5322 116 54484	140	1	MR25	METAL FILM
R 1839	4822 110 63027	1	5	CR25	CARBON
R 1846	5322 116 54734	249K	1	MR25	METAL FILM
R 1847	5322 116 54734	249K	1	MR25	METAL FILM
R 1848	4822 110 63187	1M	5	CR25	CARBON
R 1849	5322 116 54619	10K	1	MR25	METAL FILM
R 1851	5322 116 54683	68,1K	1	MR25	METAL FILM
R 1852	5322 116 54734	249K	1	MR25	METAL FILM
R 1853	5322 116 55258	511K	1	MR25	METAL FILM
R 1854	4822 110 63187	1M	5	CR25	CARBON
R 1856	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1857	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1858	5322 116 54549	1K	1	MR25	METAL FILM
R 1861	4822 110 42214	10M	5	VR37	CARBON
R 1876	5322 116 54469	100	1	MR25	METAL FILM
R 1901	5322 116 54462	82,5	1	MR25	METAL FILM
R 1902	5322 116 54641	19,6K	1	MR25	METAL FILM
R 1903	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1904	5322 116 54525	511	1	MR25	METAL FILM
R 1906	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1907	5322 116 54536	750	1	MR25	METAL FILM
R 1908	5322 116 54561	1,33K	1	MR25	METAL FILM
R 1909	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1911	5322 116 54549	1K	1	MR25	METAL FILM
R 1912	5322 116 54469	100	1	MR25	METAL FILM
R 1913	5322 116 54549	1K	1	MR25	METAL FILM
R 2001	5322 116 54567	1,69K	1	MR25	METAL FILM
R 2002	5322 116 51052	42,2	1	MR25	METAL FILM
R 2003	5322 116 51052	42,2	1	MR25	METAL FILM
R 2004	5322 116 50491	22,6	1	MR25	METAL FILM
R 2006	5322 116 54619	10K	1	MR25	METAL FILM
R 2007	5322 116 50481	22,6K	1	MR25	METAL FILM
R 2008	5322 116 54525	511	1	MR25	METAL FILM
R 2009	5322 116 50671	2,61K	1	MR25	METAL FILM

R 2011	5322 116 54567	1,69K	1	MR25	METAL FILM
R 2012	5322 116 54606	7,15K	1	MR25	METAL FILM
R 2014	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2016	5322 116 54005	3,32K	1	MR25	METAL FILM
R 2017	5322 116 50536	464	1	MR25	METAL FILM
R 2018	5322 116 50664	2,05K	1	MR25	METAL FILM
R 2019	5322 116 50669	205	1	MR25	METAL FILM
R 2021	5322 116 50572	12,1K	1	MR25	METAL FILM
R 2022	5322 116 54536	750	1	MR25	METAL FILM
R 2023	5322 116 54557	1,21K	1	MR25	METAL FILM
R 2024	5322 116 50583	5,9K	1	MR25	METAL FILM
R 2026	5322 116 50491	22,6	1	MR25	METAL FILM
R 2027	5322 116 50491	22,6	1	MR25	METAL FILM
R 2028	5322 116 50572	12,1K	1	MR25	METAL FILM
R 2029	5322 116 54009	562	1	MR25	METAL FILM
R 2030	5322 116 54549	1K	1	MR25	METAL FILM
R 2031	5322 116 54683	68,1K	1	MR25	METAL FILM
R 2032	5322 116 54592	4,02K	1	MR25	METAL FILM
R 2033	5322 116 54549	1K	1	MR25	METAL FILM
R 2037	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 2038	5322 116 50491	22,6	1	MR25	METAL FILM
R 2039	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 2041	5322 116 54549	1K	1	MR25	METAL FILM
R 2042	5322 116 54549	1K	1	MR25	METAL FILM
R 2043	5322 116 50482	33,2K	1	MR25	METAL FILM
R 2044	5322 116 50491	22,6	1	MR25	METAL FILM
R 2046	5322 116 54692	86,6K	1	MR25	METAL FILM
R 2047	5322 116 54743	301K	1	MR25	METAL FILM
R 2048	5322 101 14071	100K	20	0.5W	TRIMMING POTM
R 2049	5322 116 50481	22,6K	1	MR25	METAL FILM
R 2051	4822 110 42218	15M	5	VR37	CARBON
R 2052	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2053	5322 116 54595	5,11K	1	MR25	METAL FILM
R 2054	5322 116 54549	1K	1	MR25	METAL FILM
R 2056	5322 116 50558	18,7K	1	MR25	METAL FILM
R 2057	5322 116 54678	59K	1	MR25	METAL FILM
R 2058	5322 116 54743	301K	1	MR25	METAL FILM
R 2059	5322 116 50536	464	1	MR25	METAL FILM
R 2061	5322 116 54561	1,33K	1	MR25	METAL FILM
R 2062	5322 116 54696	100K	1	MR25	METAL FILM
R 2063	5322 116 50491	22,6	1	MR25	METAL FILM
R 2064	5322 116 54683	68,1K	1	MR25	METAL FILM
R 2065	5322 116 54696	100K	1	MR25	METAL FILM
R 2067	5322 116 50572	12,1K	1	MR25	METAL FILM
R 2068	5322 116 50491	22,6	1	MR25	METAL FILM
R 2069	5322 116 54678	59K	1	MR25	METAL FILM
R 2071	5322 101 14071	100K	20	0.5W	TRIMMING POTM
R 2072	4822 110 42214	10M	5	VR37	CARBON
R 2073	4822 110 42218	15M	5	VR37	CARBON
R 2074	4822 110 42201	3,3M	5	VR37	CARBON
R 2077	5322 116 54619	10K	1	MR25	METAL FILM
R 2078	4822 110 63187	1M	5	CR25	CARBON
R 2079	4822 110 63187	1M	5	CR25	CARBON
R 2081	5322 116 54549	1K	1	MR25	METAL FILM
R 2082	5322 116 54549	1K	1	MR25	METAL FILM
R 2083	5322 116 54743	301K	1	MR25	METAL FILM
R 2084	5322 116 55284	681K	1	MR25	METAL FILM
R 2086	5322 116 54619	10K	1	MR25	METAL FILM
R 2087	5322 116 54469	100	1	MR25	METAL FILM
R 2088	5322 116 54696	100K	1	MR25	METAL FILM
R 2089	5322 116 54696	100K	1	MR25	METAL FILM
R 2091	5322 116 50491	22,6	1	MR25	METAL FILM
R 2092	5322 116 50491	22,6	1	MR25	METAL FILM
R 2093	5322 116 50491	22,6	1	MR25	METAL FILM
R 2094	5322 116 50491	22,6	1	MR25	METAL FILM
R 2095	5322 116 54619	10K	1	MR25	METAL FILM
R 2096	5322 116 50491	22,6	1	MR25	METAL FILM
R 2097	5322 116 50491	22,6	1	MR25	METAL FILM
R 2098	5322 116 50479	15,4K	1	MR25	METAL FILM
R 2099	5322 116 50527	33,2	1	MR25	METAL FILM

R 2100	5322 116 50527	33,2	1	MR25	METAL FILM
R 2101	5322 116 54504	274	1	MR25	METAL FILM
R 2201	5322 111 94157	4X270			WIRE-WOUND
R 2202	5322 111 94157	4X270			WIRE-WOUND
R 2203	5322 111 94158	8X180			WIRE-WOUND
R 2204	5322 116 50491	22,6	1	MR25	METAL FILM
R 2206	5322 116 50491	22,6	1	MR25	METAL FILM
R 2207	5322 116 50491	22,6	1	MR25	METAL FILM
R 2208	5322 116 50491	22,6	1	MR25	METAL FILM
R 2209	5322 116 50491	22,6	1	MR25	METAL FILM
R 2211	5322 116 50491	22,6	1	MR25	METAL FILM
R 2212	5322 116 50491	22,6	1	MR25	METAL FILM
R 2213	5322 116 50491	22,6	1	MR25	METAL FILM
R 2214	5322 116 54476	115	1	MR25	METAL FILM
R 2216	5322 116 50457	215	1	MR25	METAL FILM
R 2217	5322 111 94158	8X180			WIRE-WOUND
R 2218	5322 116 54678	59K	1	MR25	METAL FILM
R 2219	5322 111 94157	4X270			WIRE-WOUND
R 2221	5322 111 94157	4X270			WIRE-WOUND
R 2301	5322 111 94152	1K	2	4X0.3W	WIRE-WOUND
R 2302	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 2303	5322 111 94153	4,7K	2	4X0.3W	WIRE-WOUND
R 2306	5322 111 94154	10K	2	4X1W	WIRE-WOUND
R 2307	5322 111 44204	22M	5	0.125W	CARBON
R 2308	5322 111 44205	300K	5	0.125W	CARBON
R 2311	5322 111 94155	100K	2	4X1W	WIRE-WOUND
R 2312	5322 111 94155	100K	2	4X1W	WIRE-WOUND
R 2313	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 2316	5322 116 64075	20K	5	0.125W	METAL OXIDE
R 2317	4822 116 51123	1K	5	0.125W	METAL FILM
R 2318	5322 116 64076	620	5	0.125W	METAL OXIDE
R 2321	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 2322	5322 111 94154	10K	2	4X1W	WIRE-WOUND
R 2323	5322 116 64077	1,3K	5	0.125W	METAL OXIDE
R 2324	5322 116 50452	10	1	MR25	METAL FILM
R 2401	5322 111 94156	4,7K	2	4X1W	WIRE-WOUND
R 2402	5322 116 54192	5,11	1	MR25	METAL FILM
R 2403	5322 116 54469	100	1	MR25	METAL FILM
R 2407	5322 116 54504	274	1	MR25	METAL FILM
R 2408	5322 116 54484	140	1	MR25	METAL FILM
R 2411	5322 116 50767	2,15K	1	MR25	METAL FILM
R 2412	5322 116 50675	2,26K	1	MR25	METAL FILM
R 2413	5322 116 54532	649	1	MR25	METAL FILM
R 2416	5322 116 54532	649	1	MR25	METAL FILM
R 2417	5322 116 50608	6,19K	1	MR25	METAL FILM
R 2418	5322 116 54504	274	1	MR25	METAL FILM
R 2419	5322 116 54504	274	1	MR25	METAL FILM
R 2421	5322 116 54547	953	1	MR25	METAL FILM
R 2422	5322 116 54549	1K	1	MR25	METAL FILM
R 2423	5322 116 50561	590	1	MR25	METAL FILM
R 2424	5322 116 54504	274	1	MR25	METAL FILM
R 2426	5322 116 50561	590	1	MR25	METAL FILM
R 2427	5322 116 54562	1,4K	1	MR25	METAL FILM
R 2428	5322 116 54012	6,81K	1	MR25	METAL FILM
R 2431	5322 116 54513	332	1	MR25	METAL FILM
R 2432	5322 116 54469	100	1	MR25	METAL FILM
R 2433	5322 116 50636	2,74K	1	MR25	METAL FILM
R 2436	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2437	5322 116 50669	205	1	MR25	METAL FILM
R 2438	5322 116 54549	1K	1	MR25	METAL FILM
R 2439	5322 116 54192	5,11	1	MR25	METAL FILM
R 2441	5322 116 54504	274	1	MR25	METAL FILM
R 2442	5322 116 54484	140	1	MR25	METAL FILM
R 2443	5322 116 54504	274	1	MR25	METAL FILM
R 2451	5322 111 94156	4,7K	2	4X1W	WIRE-WOUND
R 2461	5322 111 94156	4,7K	2	4X1W	WIRE-WOUND
R 2471	5322 111 94156	4,7K	2	4X1W	WIRE-WOUND
R 2482	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2484	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2487	5322 116 54504	274	1	MR25	METAL FILM

R 2494	5322 116 54504	274	1	MR25	METAL FILM
R 2495	5322 116 54619	10K	1	MR25	METAL FILM
R 2496	5322 116 54619	10K	1	MR25	METAL FILM
R 2497	5322 116 54648	24,9K	1	MR25	METAL FILM
R 2501	5322 116 50482	33,2K	1	MR25	METAL FILM
R 2502	5322 116 54549	1K	1	MR25	METAL FILM
R 2503	5322 116 50675	2,26K	1	MR25	METAL FILM
R 2551	5322 116 50669	205	1	MR25	METAL FILM
R 2552	5322 116 54489	169	1	MR25	METAL FILM
R 2600	5322 116 54469	100	1	MR25	METAL FILM
R 2601	5322 116 50664	2,05K	1	MR25	METAL FILM
R 2605	5322 116 54549	1K	1	MR25	METAL FILM
R 2609	5322 116 54696	100K	1	MR25	METAL FILM
R 2621	5322 116 54696	100K	1	MR25	METAL FILM
R 2652	5322 116 50484	4,64K	1	MR25	METAL FILM
R 2653	5322 116 54012	6,81K	1	MR25	METAL FILM
R 2654	5322 116 54549	1K	1	MR25	METAL FILM

DIODES

Type	Ordering code
BA 280	5322 130 34302
BAV 45	5322 130 34037
BAV 70	5322 130 34331
BAV 99	5322 130 34337
BAW 56	4822 130 30613
BAW 62	5322 130 30691
BAX 12	5322 130 34605
BAX 17	5322 130 30605
BBY 31	5322 130 34689
BY 206	4822 130 30839
BY 208-1000	4822 130 31051
BY 224- 600	5322 130 34761
BY 409	5322 130 34594
BYX 10	4822 130 30195
BYX 55- 600	5322 130 34324
IN 5820	
V 103R2	5322 130 44712
BZX 75/C1V4	4822 130 34047
BZX 75/C2V1	4822 130 34049
BZX 75/C3V6	4822 130 30765
BZX 79/B6V2	4822 130 34167
BZX 79/C5V6	4822 130 34173
BZX 79/C8V2	5322 130 34119
BZX 79/C12	4822 130 34197
BZX 79/C15	4822 130 34281
BZX 87/C5V6	5322 130 30772

LED'S

CQY 24A-1	5322 130 34595
CQY 54	4822 130 30914
FND 367	5322 130 34811

RESISTOR CIRCUITRY'S

D102 - D152 (unit 2)	5322 116 94021
HIC P5185	5322 255 44246

OPTO COUPLER

GE 4N 35

TRANSISTORS

BC 264 A	5322 130 44476
BC 338	4822 130 44121
BC 368	5322 130 44647
BC 369	5322 130 44593
BC 549 C	4822 130 44246
BC 559 B	4822 130 44358
BD 135	4822 130 40645
BD 136	4822 130 40712

BD	232	4822 130 41207
BD	680	5322 130 44749
BF	324	5322 130 44396
BF	422	4822 130 41084
BF	423	4822 130 41106
BFR	92	5322 130 44178
BFR	92 R	5322 130 44606
BFT	25	5322 130 44458
BFT	25 R	5322 130 44459
BFT	92	5322 130 44711
BFT	92 R	5322 130 44713
BFY	90	5322 130 40493
BSS	38	4822 130 40968
BSS	68	5322 130 44247
BSV	81	5322 130 44041
BSX	20	5322 130 40417
BU	208	4822 130 44508
BUX	86	5322 130 44718
ON	471	5322 130 44605

OPERATIONAL AMPLIFIERS

LM	208 T	5322 209 85475
LM	308 T	5322 209 84659
LM	709 CH	5322 209 84452
TCA	220	5322 209 84386
μA	741 CH	5322 209 85254

TRANSISTOR ARRAYS

OQ 012		5322 209 85484
RCA	3086	5322 209 84111

DIGITAL INTEGRATED CIRCUITS

10137	DC	
10231	BA	5322 209 85956
GXB	10102 D	5322 209 85955
GXB	10104 P	
GXB	10231 P	5322 209 86003
HEF	4044 BP	5322 209 14072
N74LSOON		5322 209 84823
N74 LS02N		5322 209 85312
N74 LS03N		5322 209 85265
N74 LS04N		5322 209 85486
N74 LS08N		5322 209 84995
N74 LS22N		5322 209 85505
N74 70N		5322 209 84459
N74 LS74N		5322 209 84986
N74 LS75N		5322 209 85269
N74 LS76N		5322 209 85527
N74 LS123N		5322 209 85602
N74 LS190N		5322 209 85491
N74 LS191N		5322 209 84989
N74 LS253N		5322 209 85667
N74 LS 259N		5322 209 86007

N 8T 28N	5322 209 85727
N 8T 97 N	5322 209 85353
80 85A (μP)	5322 209 86008
2111-1N (RAM)	5322 209 14461
PROGRAMMED PROM	5322 209 54421

VARIOUS

LM	339	5322 209 85841
OM	504	5322 216 54192
TDA	1060	5322 209 85662

CATHODE RAY TUBE V1

85 D14 GH	5322 131 24047

Item	Ordering number	Type/Description
Miscellaneous		
E1	5322 134 44177	
F1	4822 253 30025	
K1701	5322 280 24076	Relay Coil
L1	5322 157 44035	Coil
L601	5322 321 24901	Coil ass.
L602	5322 321 24901	Coil ass.
L1601	5322 156 14076	Coil
L1801	5322 156 14076	Coil
L1802	5322 156 14076	Coil
L1803	5322 142 44026	Coil
L1804	5322 281 64154	Coil
L1806	5322 148 84041	Coil
L1807	5322 152 24062	Choke
L1811	4822 156 20663	Coil
L1812	4822 156 20663	Coil
L1813	4822 156 20663	Coil
L1814	4822 156 20663	Coil
L1816	5322 152 24067	Coil
L1817	5322 152 24068	Choke
L1876	5322 152 24069	Coil
L1877	5322 156 14076	Coil
L1878	5322 152 24069	Coil
S1	5322 276 64029	Switch
S2	5322 276 44063	Switch
S9	5322 273 34116	Switch
S11	5322 273 34116	Switch
S13	5322 273 44098	Switch
S19	5322 276 84063	Switch
S21	5322 276 84063	Switch
S1801	5322 277 24071	Switch
S2601	5322 277 24045	Switch
T1801	5322 148 84039	Transformer
T1876	5322 146 14171	Transformer

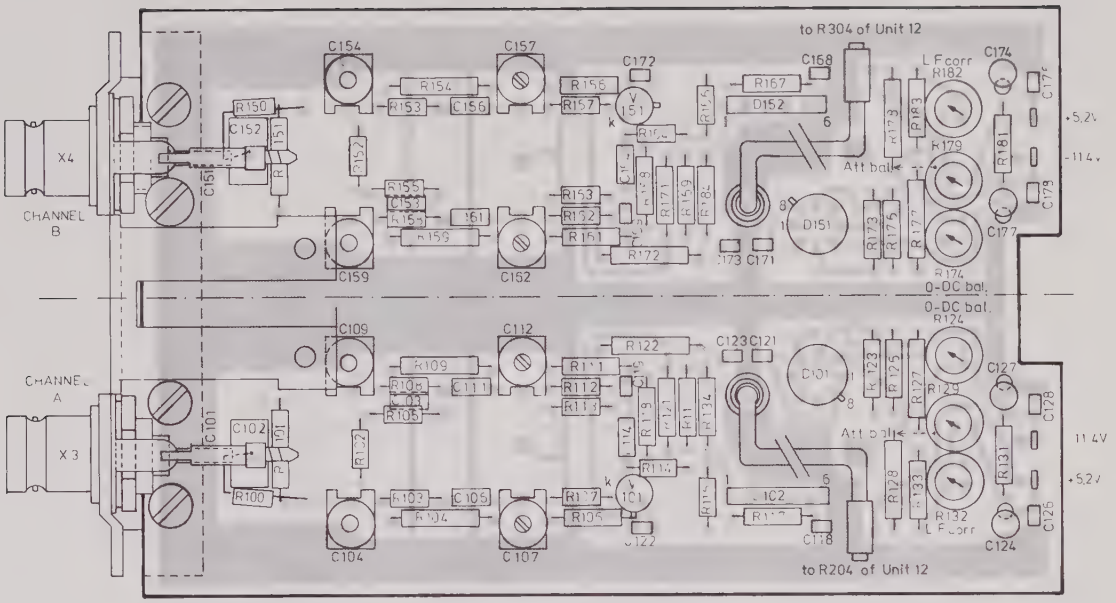


Fig. 3.46. Vertical attenuator component side (UNIT 2) MAT 47

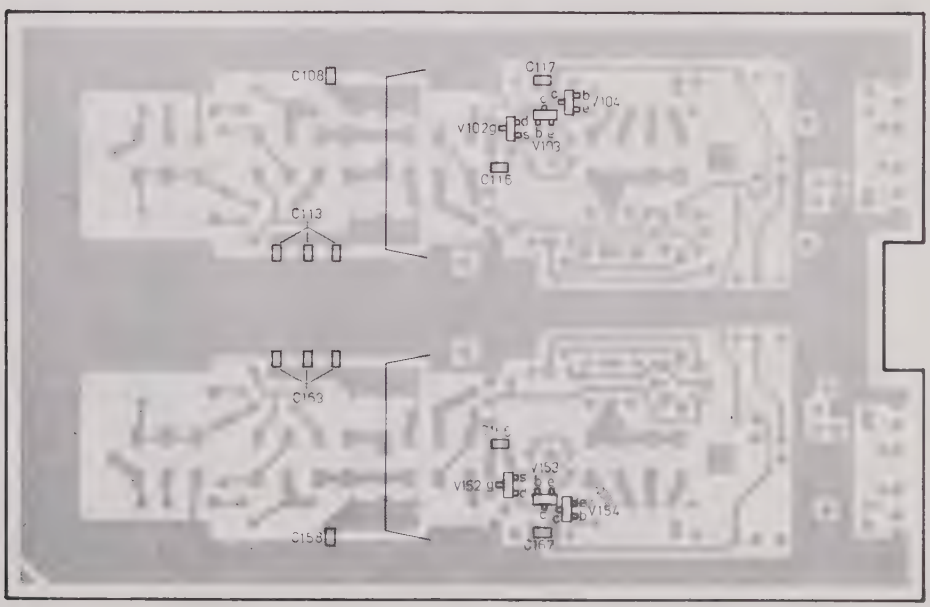
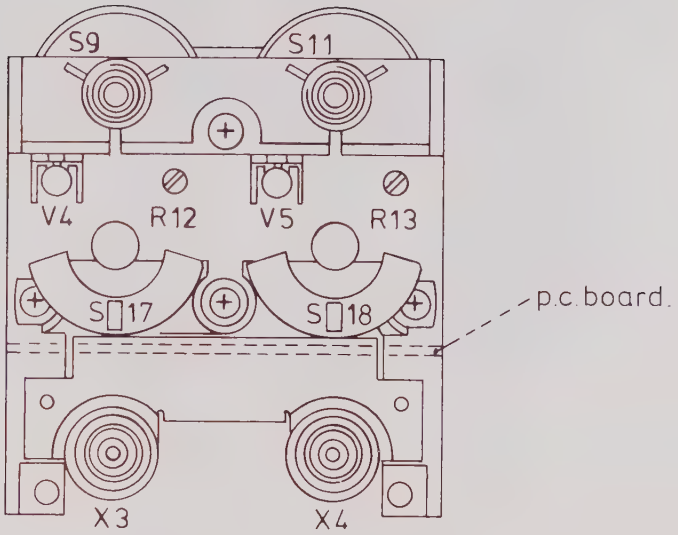


Fig. 3.47. Vertical attenuator conductor side (UNIT 2) MAT48



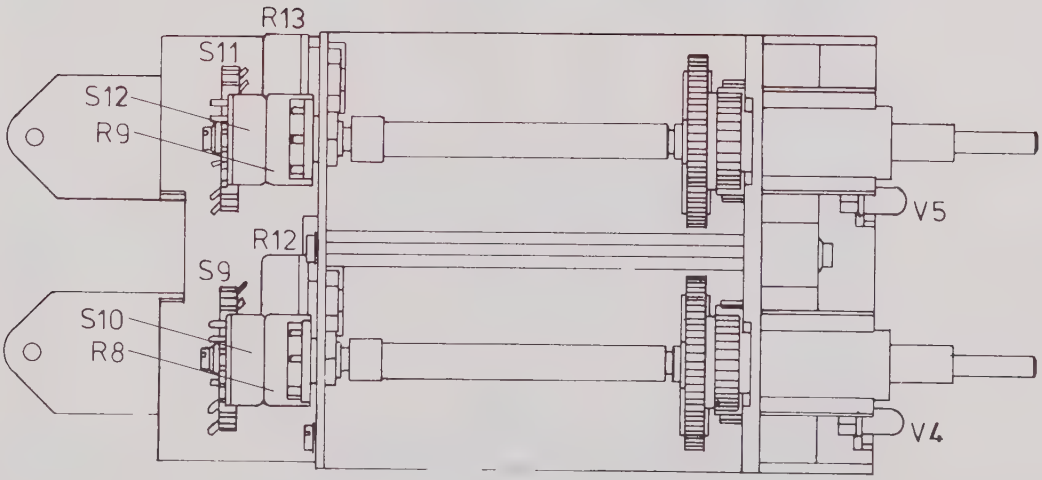


Fig. 3.48. Vertical attenuator (UNIT 2)

MAT 49

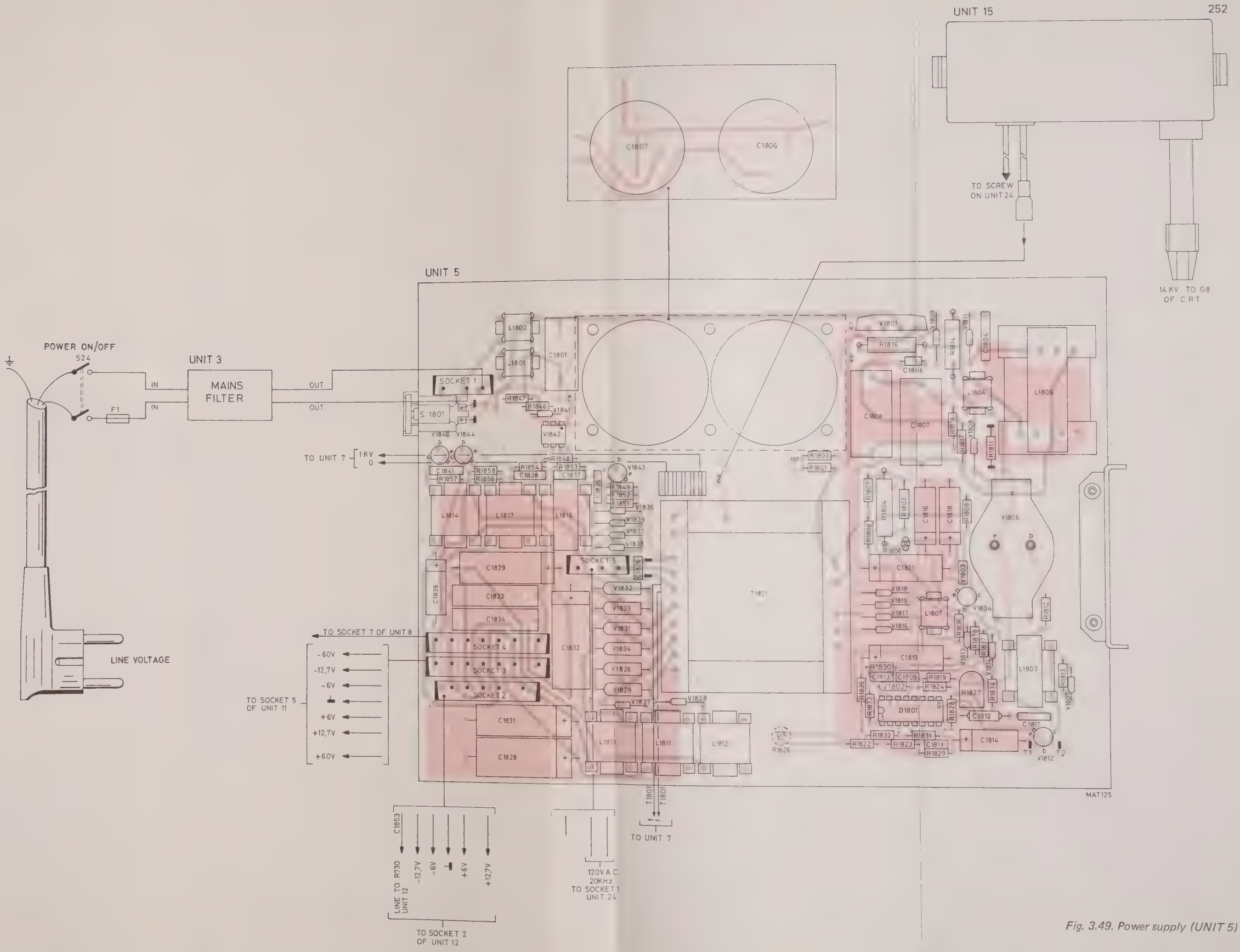


Fig. 3.49. Power supply (UNIT 5)

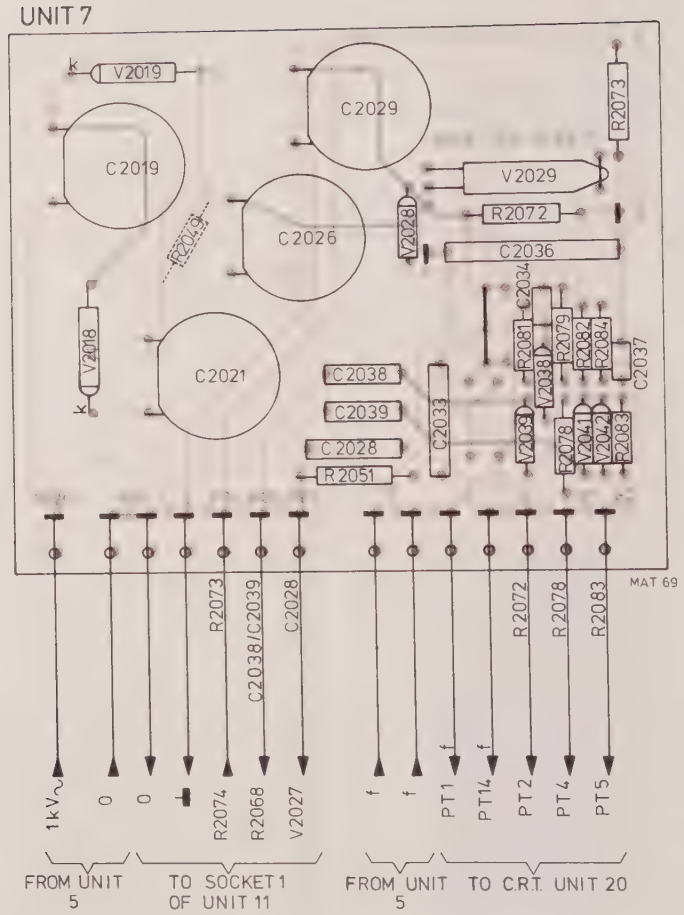


Fig. 3.50. Focus unit (UNIT 7)

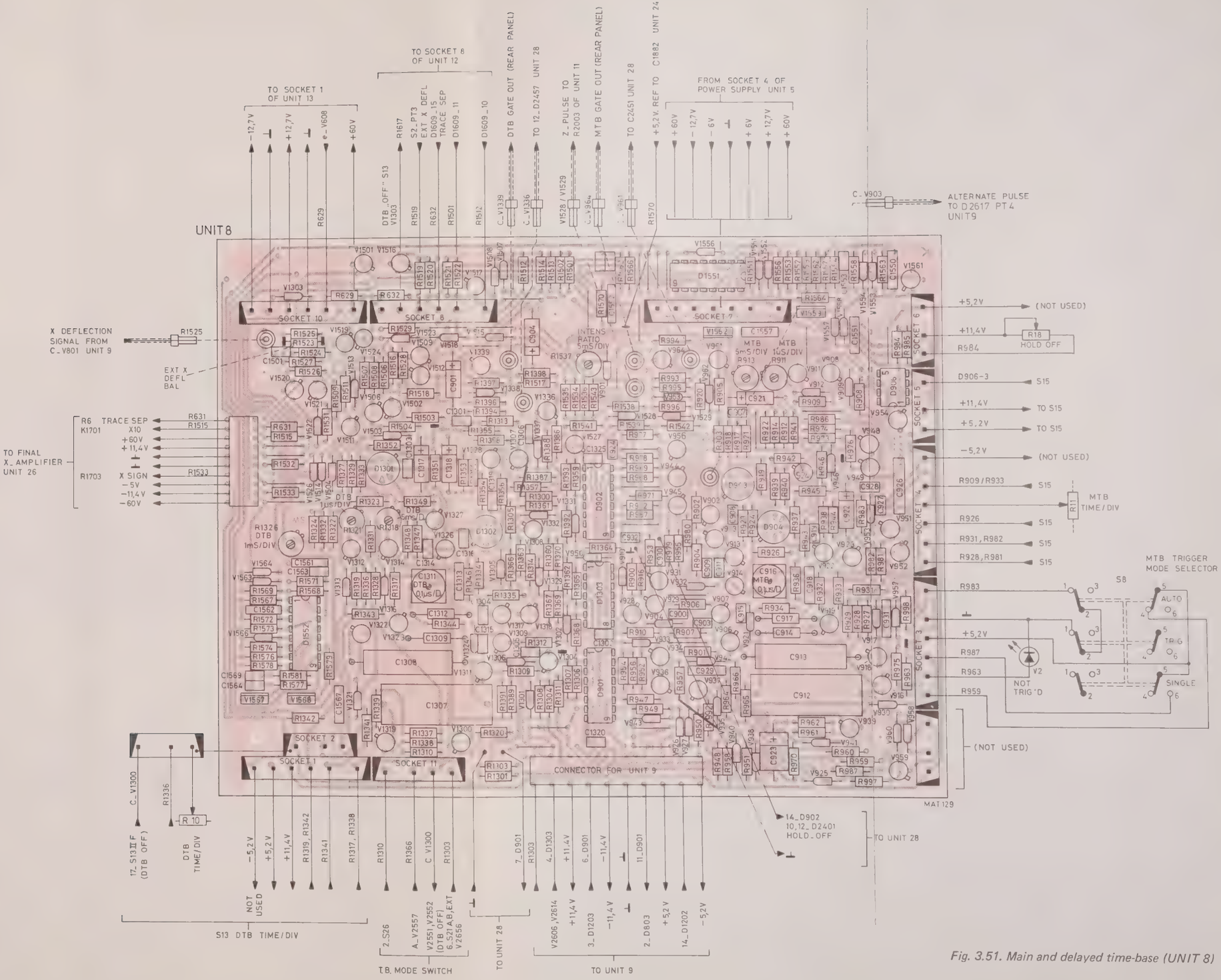


Fig. 3.51. Main and delayed time-base (UNIT 8)

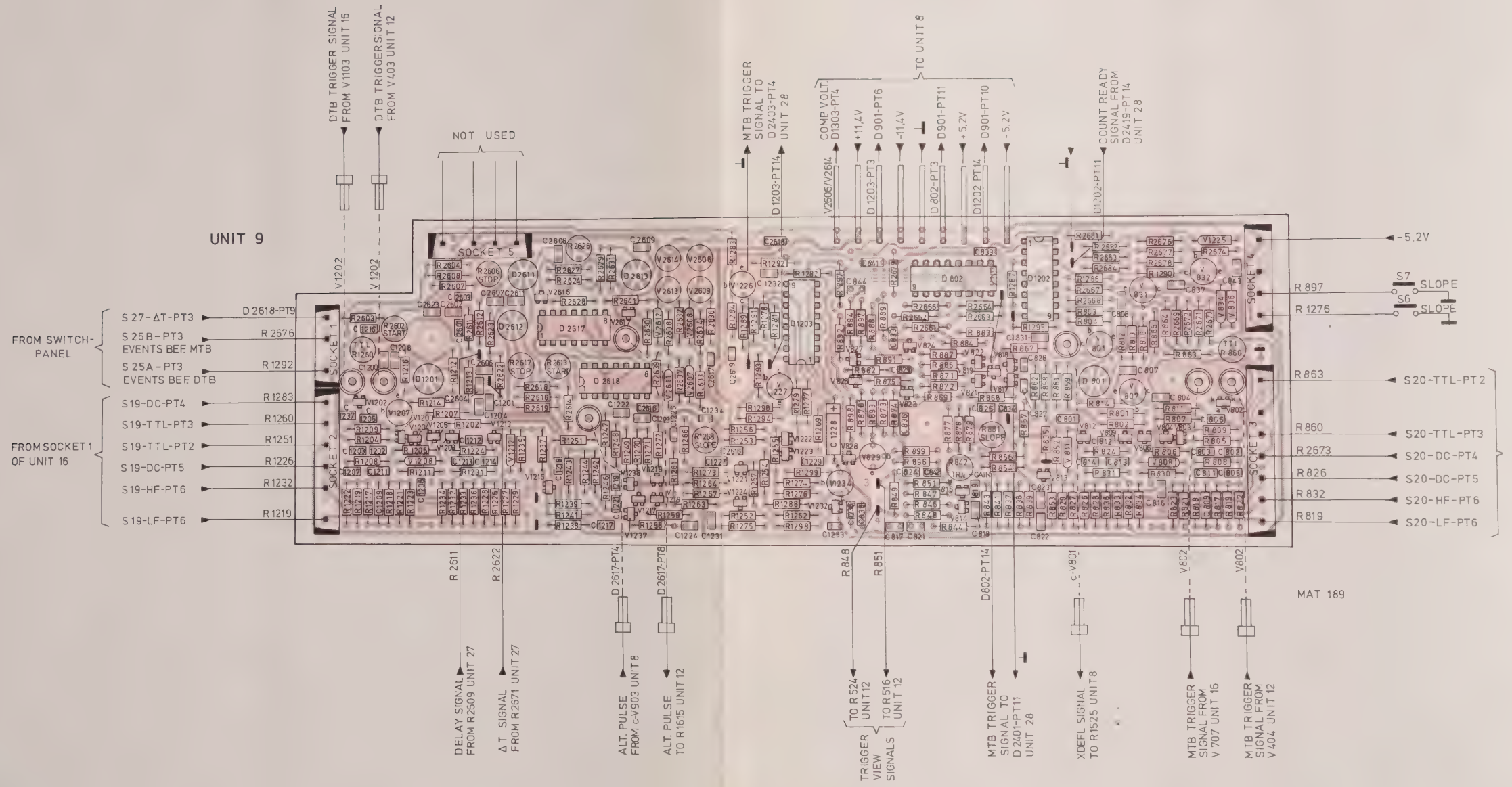


Fig. 3.52. MTB and DTB trigger unit (UNIT 9)

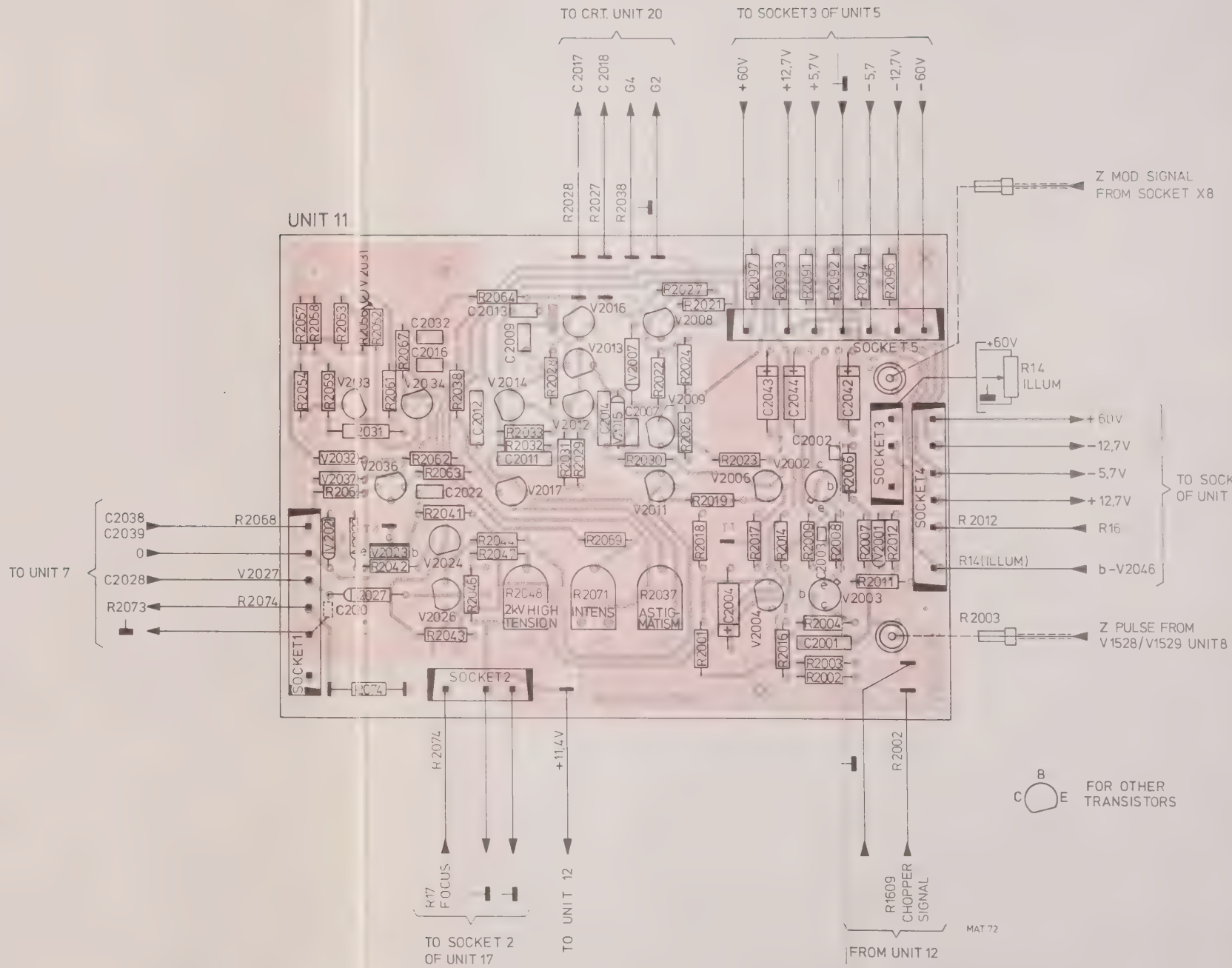


Fig. 3.53. Final Z-amplifier (UNIT 11)

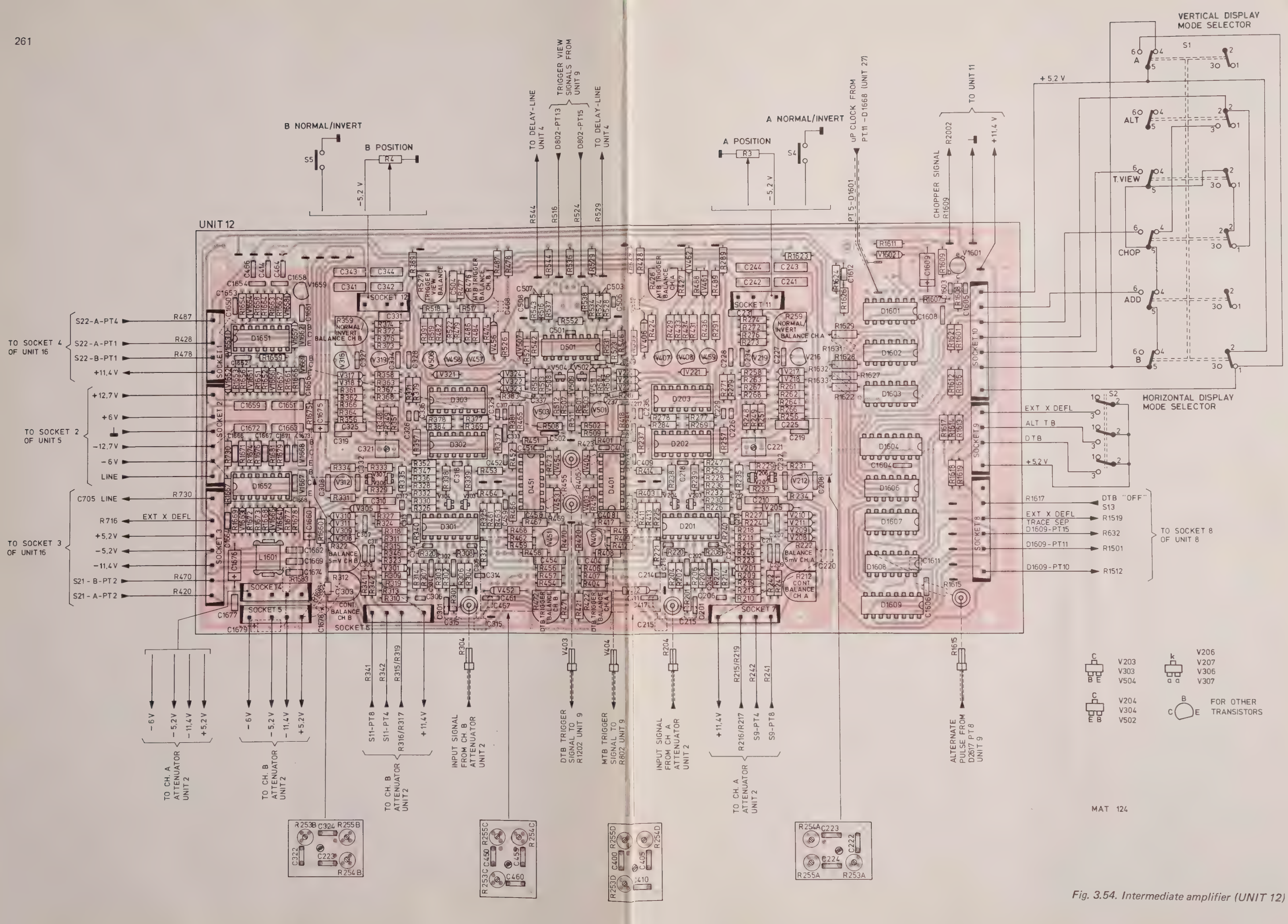
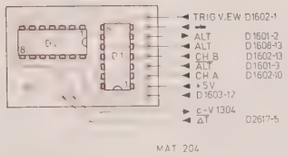
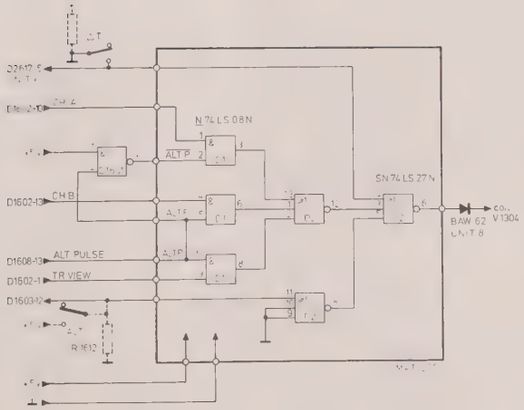


Fig. 3.54. Intermediate amplifier (UNIT 12)





Additional circuit for marker suppression.

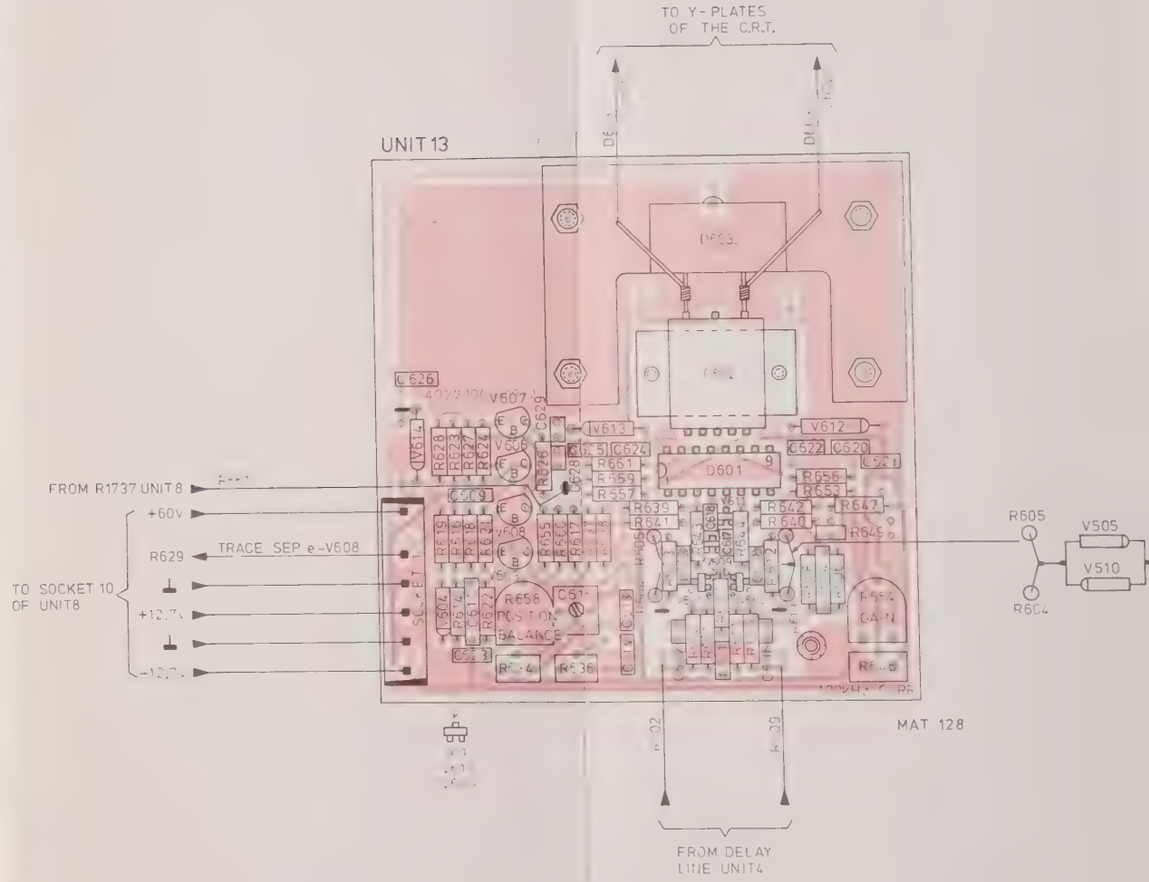


Fig. 3.55. Vertical final amplifier (UNIT 13)

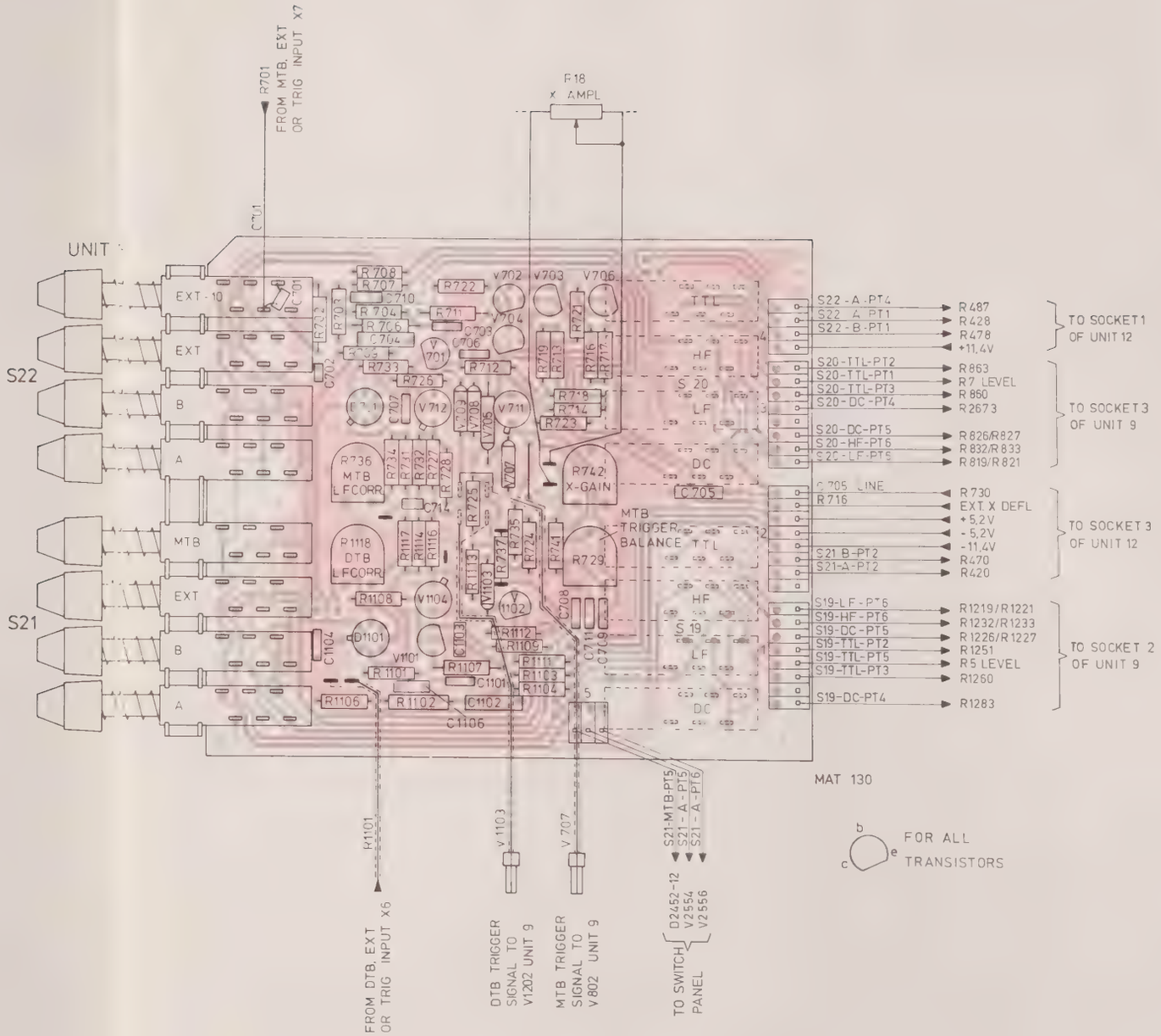


Fig. 3.56. MTB and DTB External input (UNIT 16)

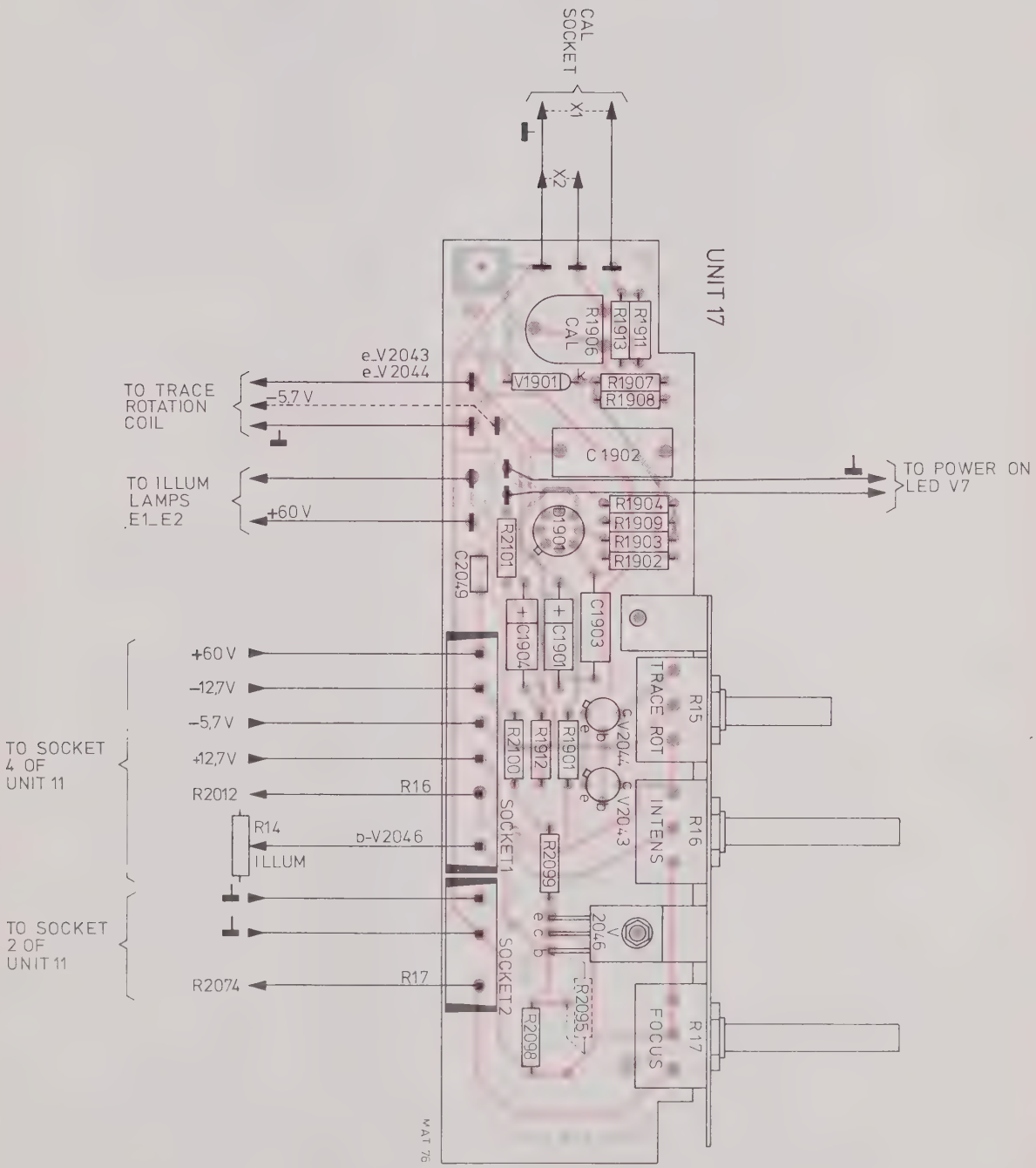


Fig. 3.57. Calibration generator unit (UNIT 17)

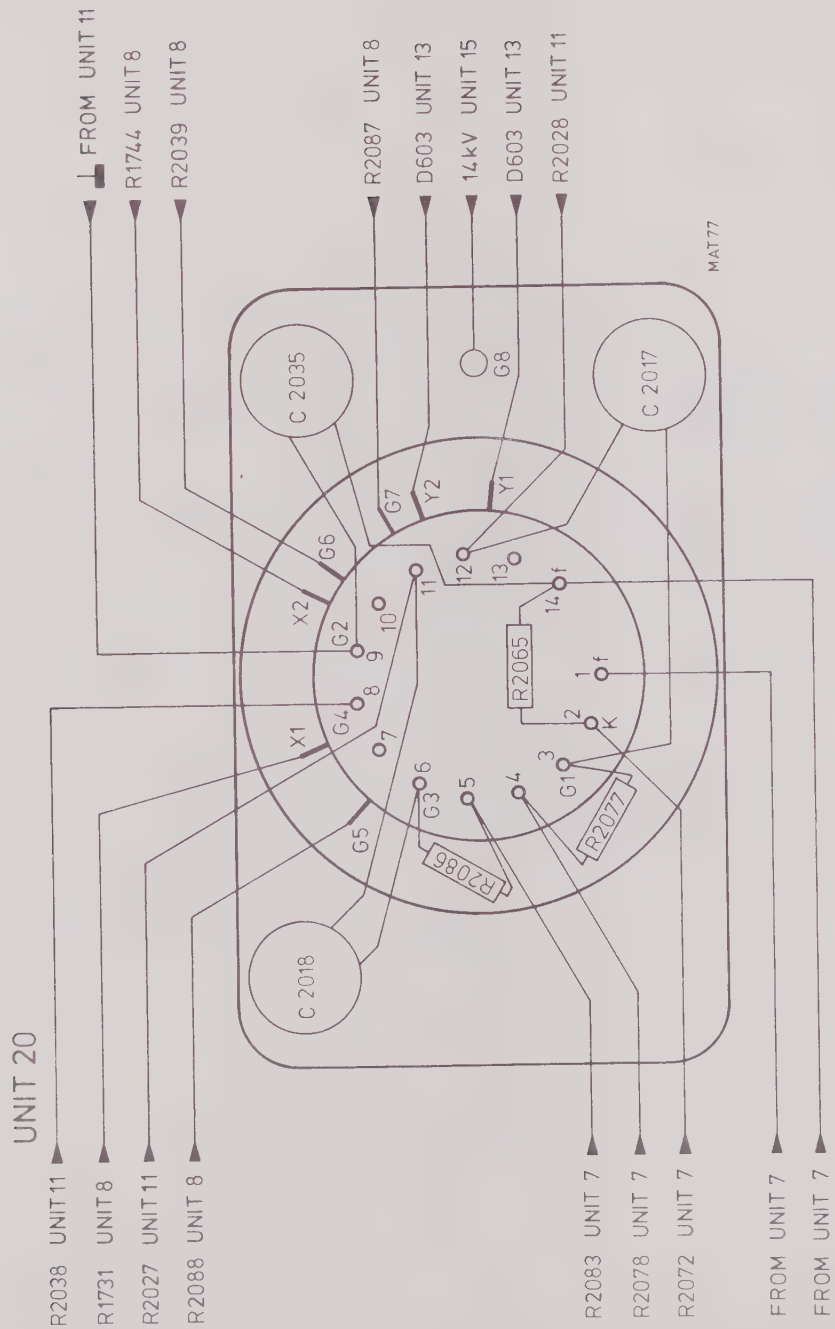


Fig. 3.58. C.R.T. unit (UNIT20)

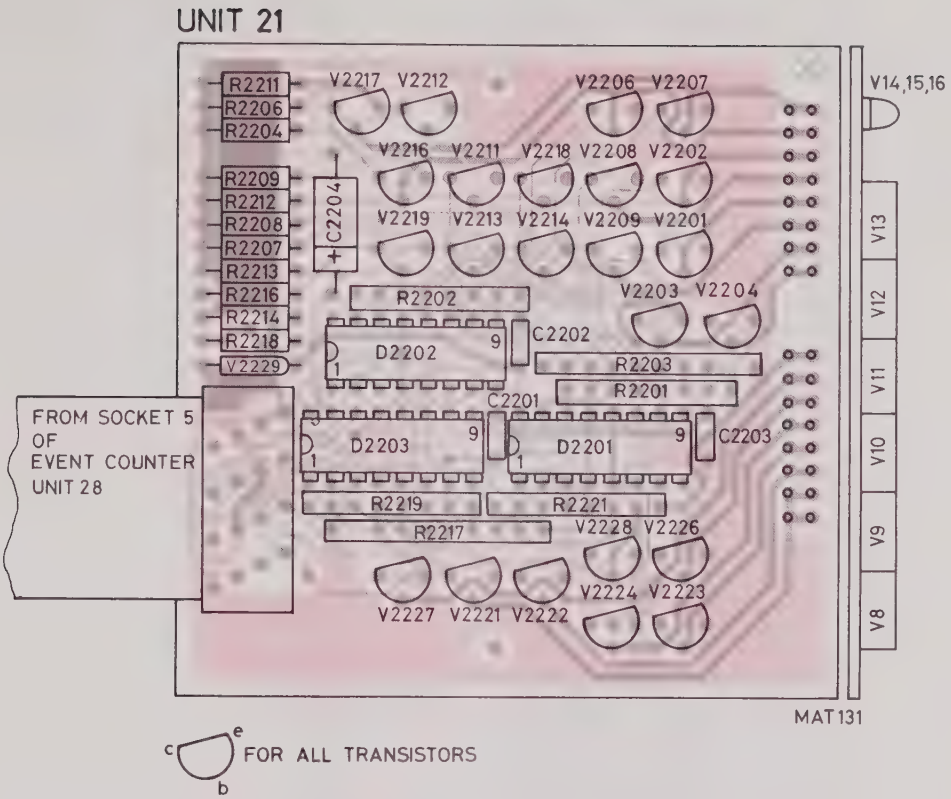


Fig. 3.59. Display unit (UNIT 21)

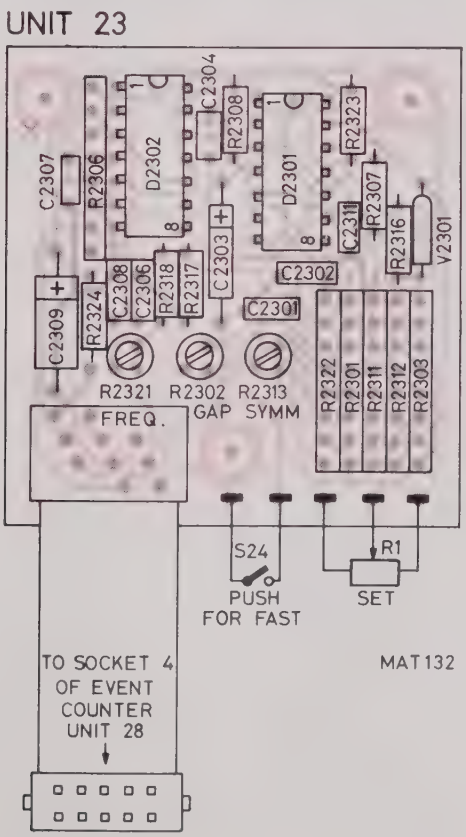


Fig. 3.60. V.C.O. unit (UNIT 23)

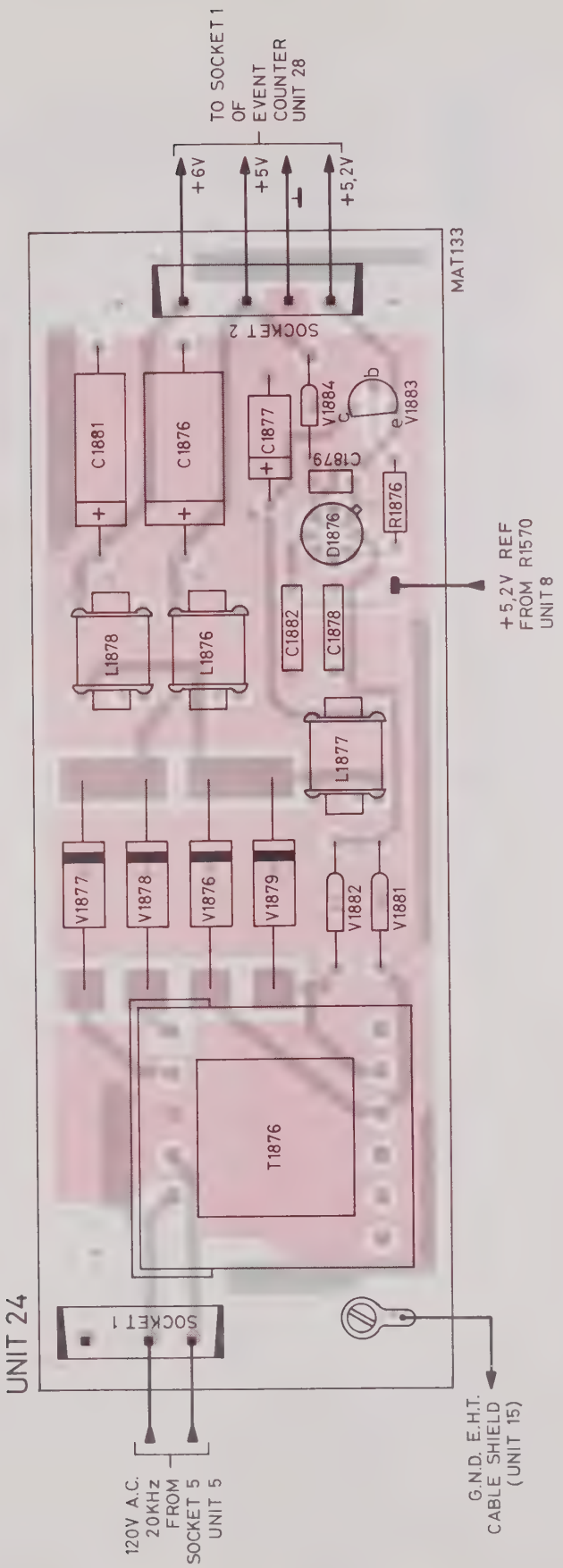


Fig. 3.61. Additional power supply (UNIT 24)

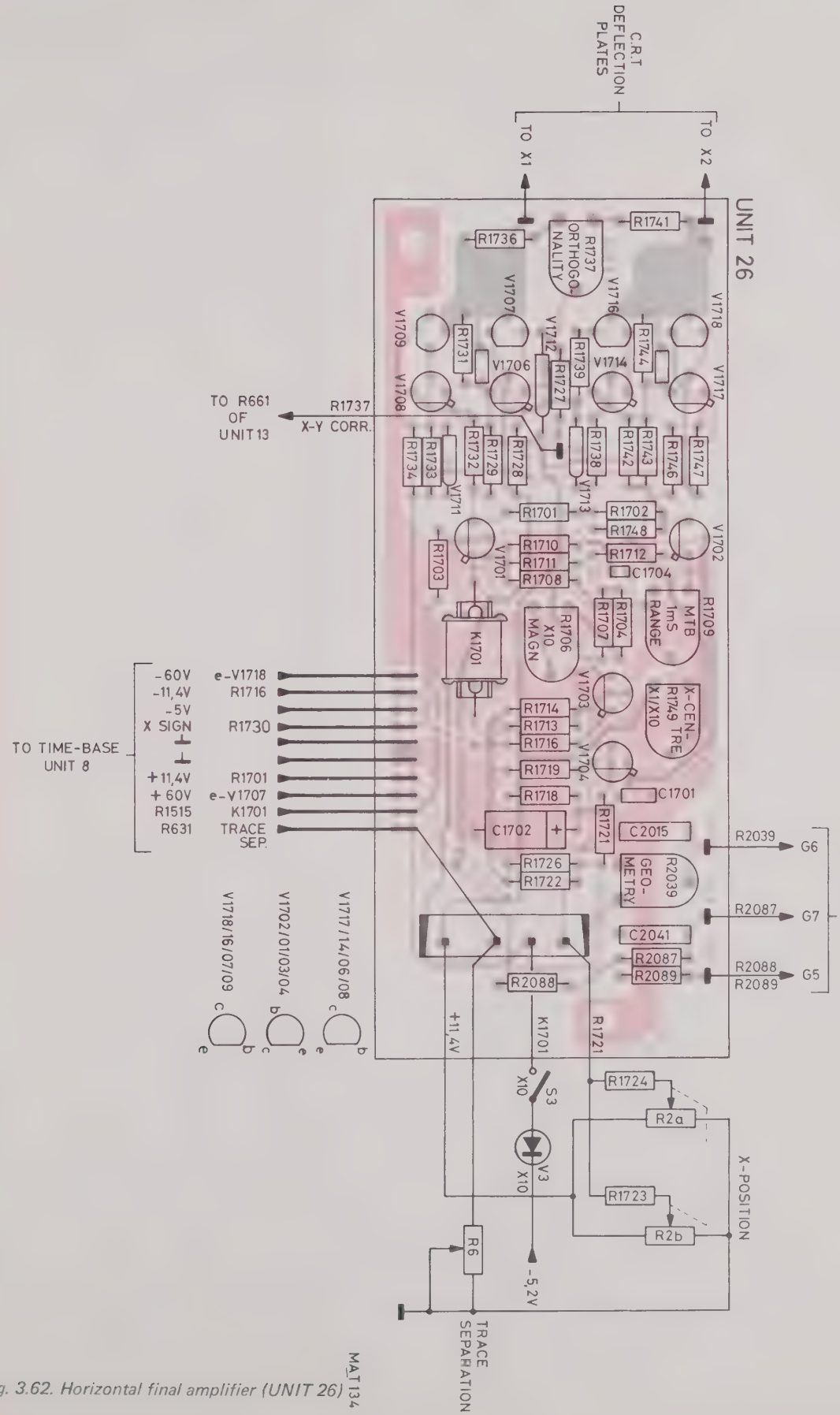


Fig. 3.62. Horizontal final amplifier (UNIT 26)

UNIT 27

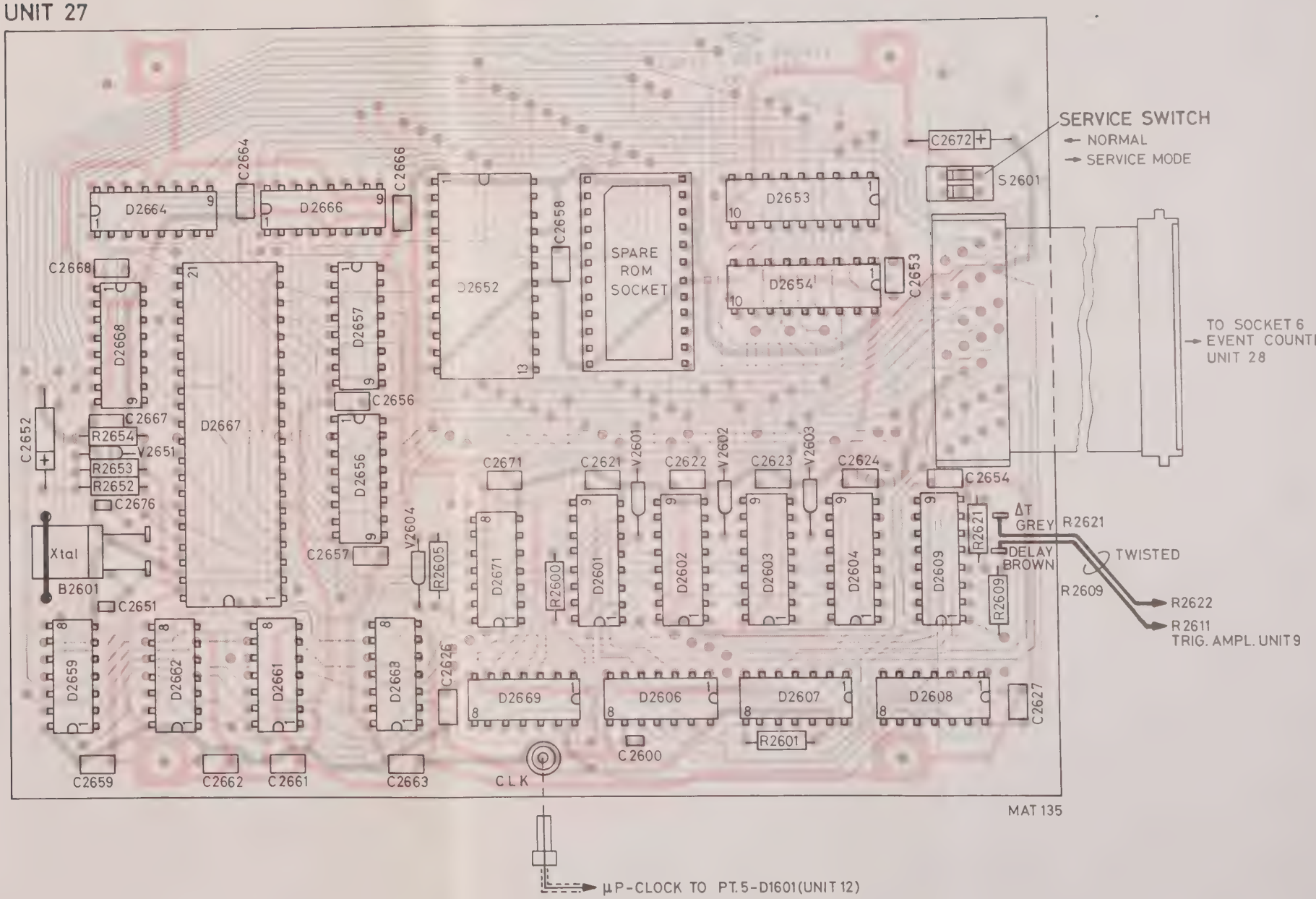


Fig. 3.63. Microprocessor unit (UNIT 27)

UNIT 28

MTB TRIGGER FROM D802-14 UNIT 9

TO MICRO PROCESSOR PRINT UNIT 27

MAIN TIME_BASE GATE FROM C_V961 (UNIT 8)

C2451

12_D2457

DELAYED TIME_BASE GATE FROM C_V1336 (UNIT8)

+6V

+5V

+5,2V

FROM ADDITIONEL POWER SUPPLY UNIT 24

HOLD OFF

HOLD OFF SIGNAL FROM PT14 D902 UNIT 8

0,12_D2401

TWISTED

C2407

DTB TRIGGER FROM UNIT 9

15_D2403

D2419 -14

MAT 136

TO LED DISPLAY UNIT 21

FROM V.C.O. UNIT 23

FROM EVENT SWITCHES

TO PT 7 D901 UNIT 8

FROM M.T.B. SWITCH S15

COUNT READY TO PT 11 D1202 UNIT 9

✳ ONLY USED IN PM3263X

Fig. 3.64. Event counter (UNIT 28)

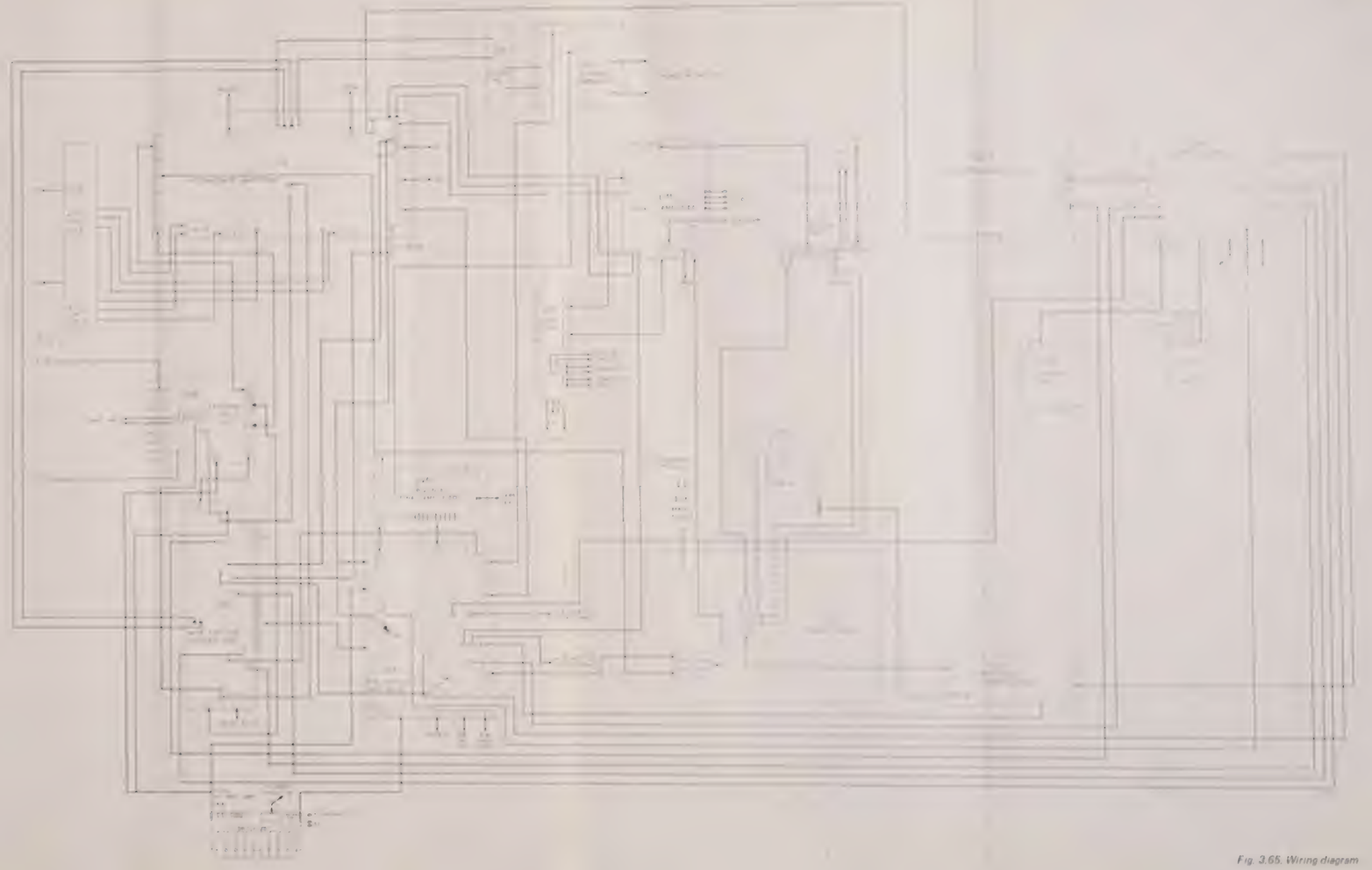
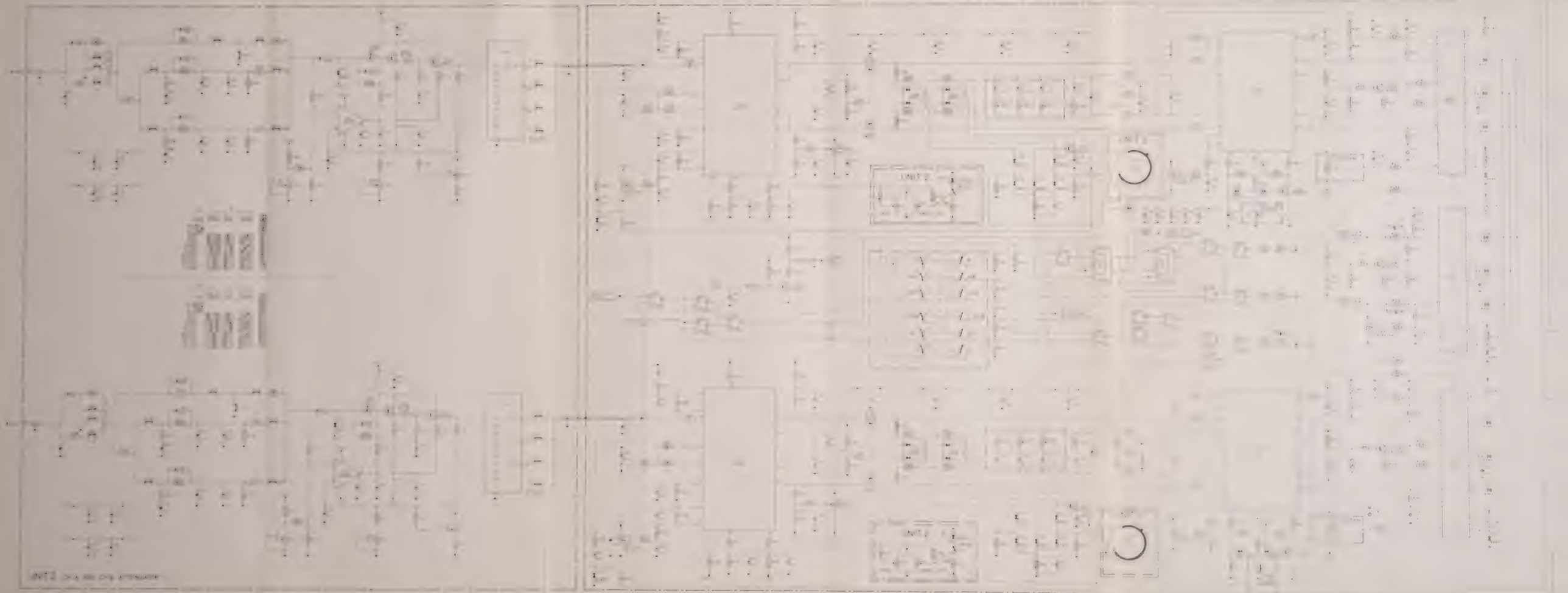


Fig. 3.65. Wiring diagram



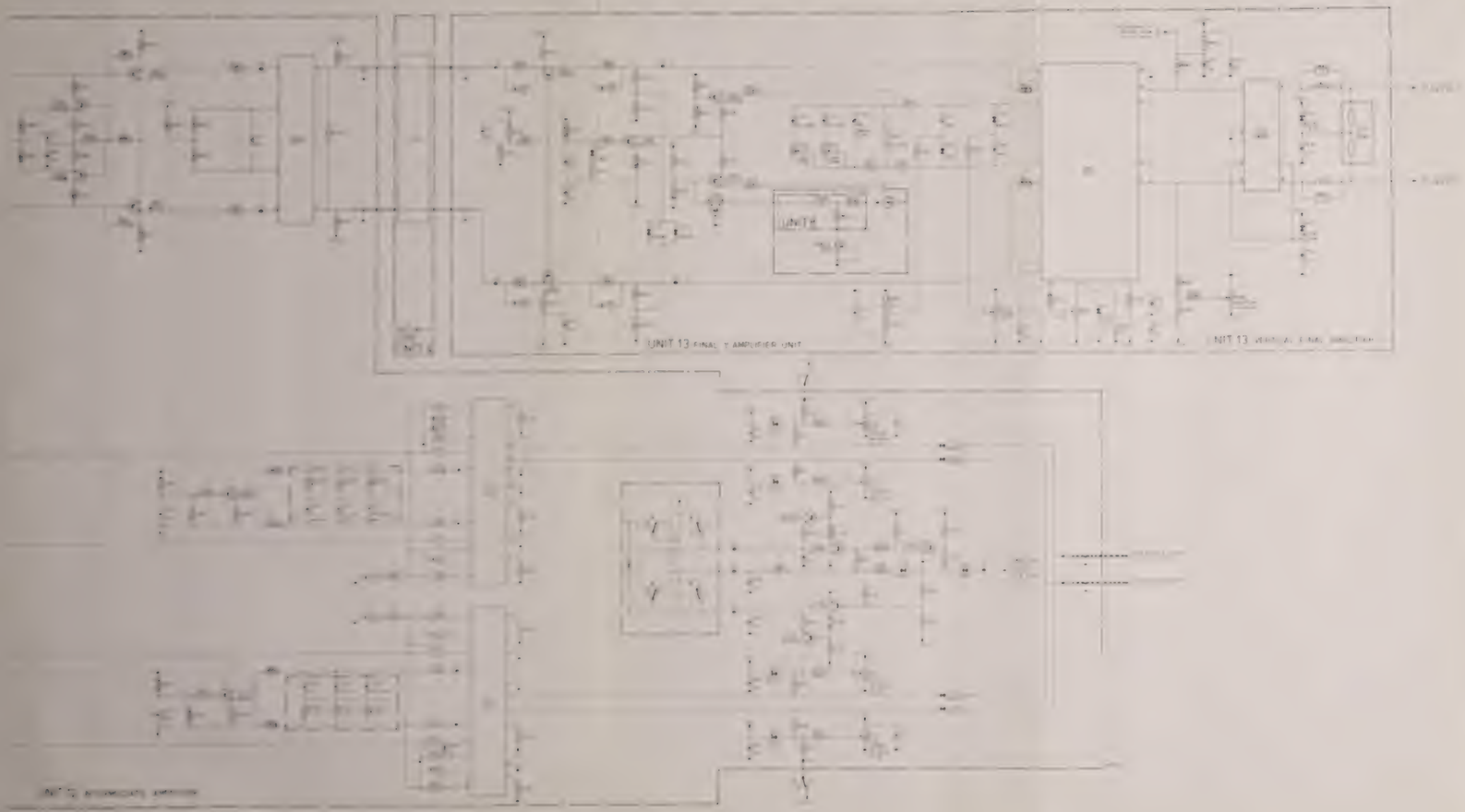
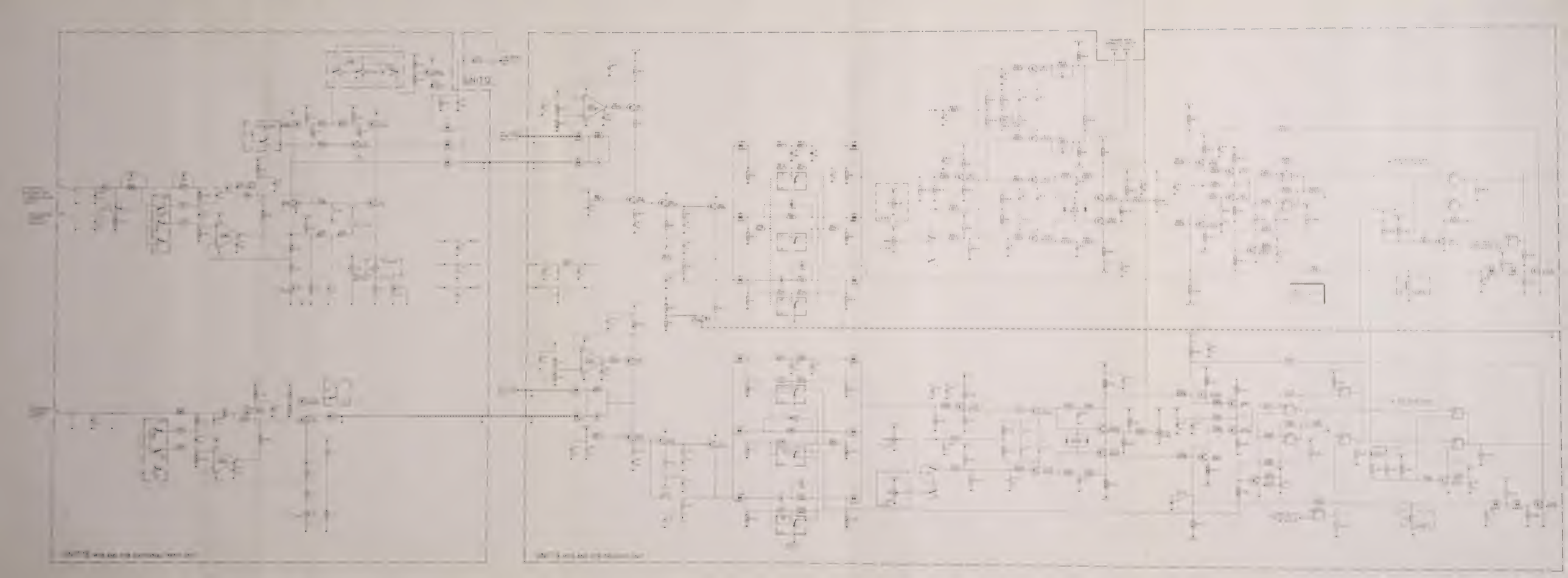


Fig. 3.66. Circuit diagram of the vertical amplifier.



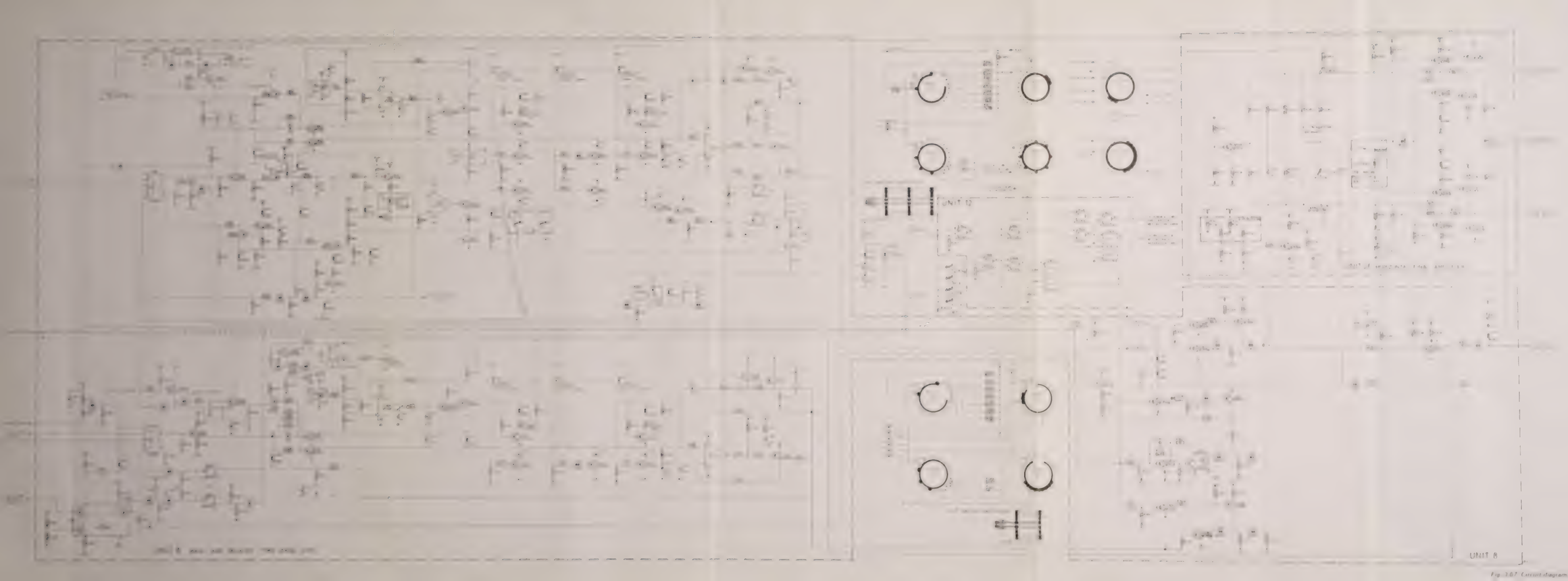


Fig. 3.67 Circuit diagram of the main and delayed time-base

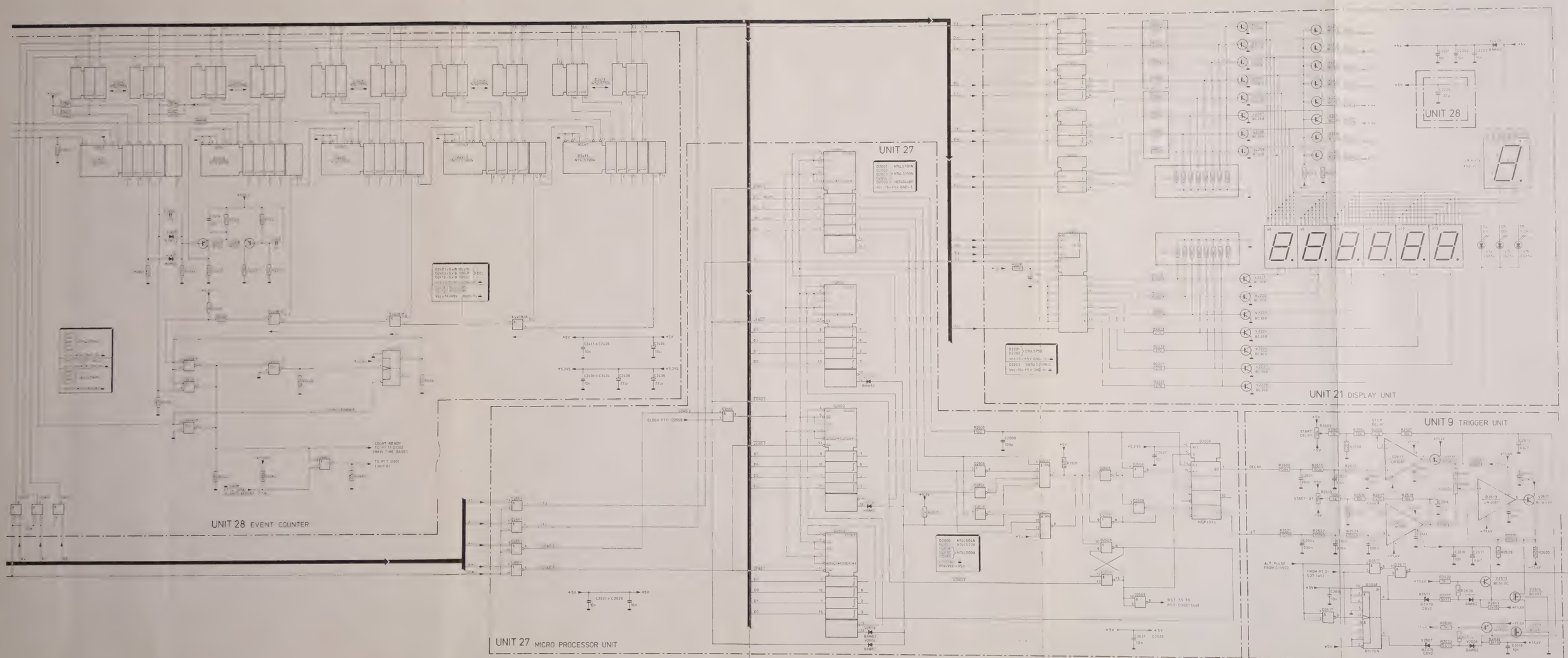
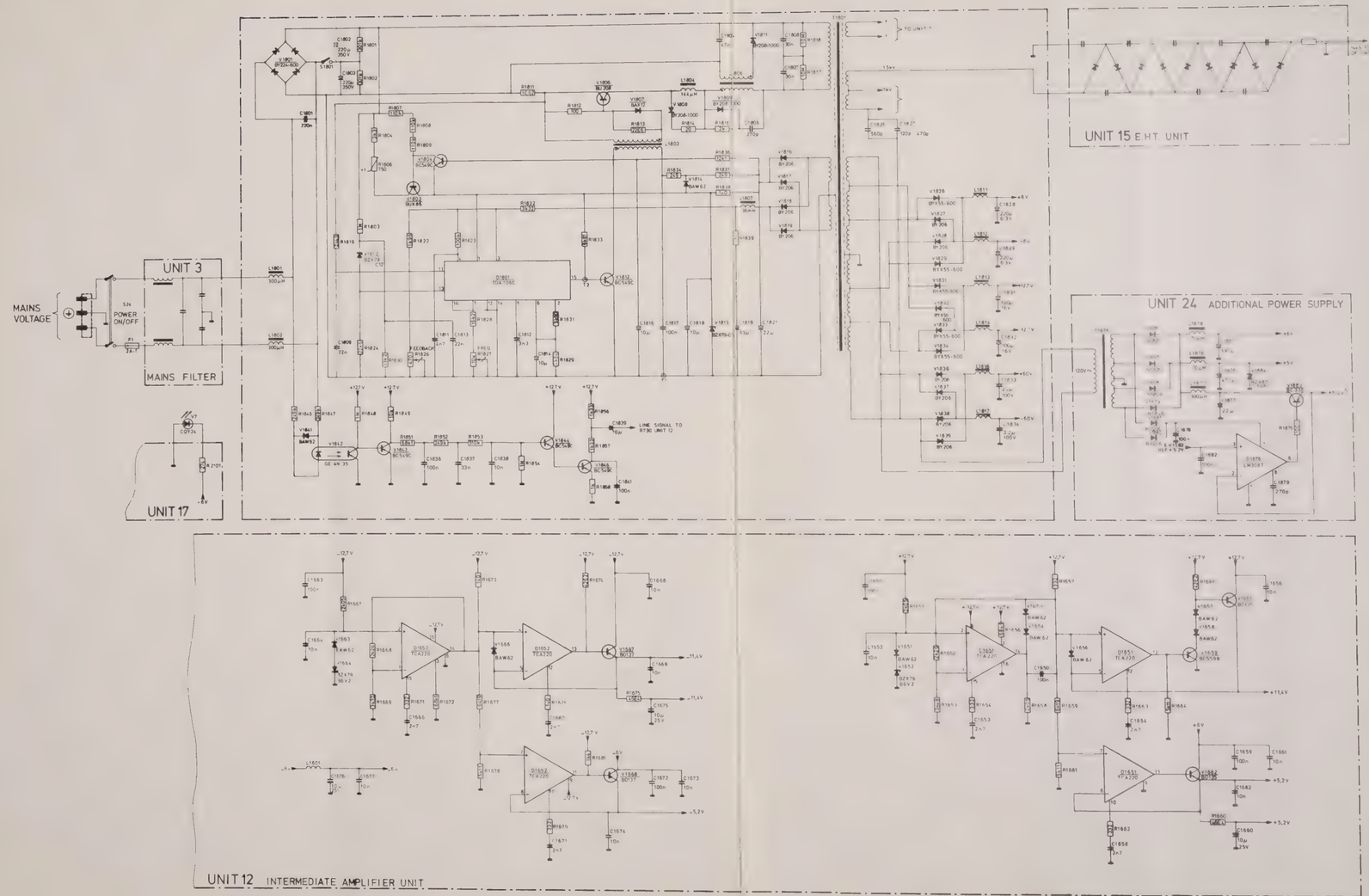

UNIT 28 EVENT COUNTER
UNIT 27 MICRO PROCESSOR UNIT
UNIT 27
UNIT 21 DISPLAY UNIT
UNIT 28
UNIT 9 TRIGGER UNIT
COUNT READY TO PT 11 D1202 (MAIN TIME BASE)
TO PT 7 D901 (UNIT 8)
CLOCK PT11-D2668
LOAD 2
LOAD 1
ALT PULSE FROM C-D902
FROM PT 3-527 (alt)
ALT PULSE TO P13-D1608 UNIT 12
COMP VOLTAGE TO PT4 D1203
RST 7.5 TO PT7-D2667 (up)
MAT 133

Fig. 3.68. Circuit diagram microprocessor and logic circuits


UNIT 3
MAINS VOLTAGE
S24 POWER ON/OFF
F1 2A T
MAINS FILTER
L1801 300µH
L1802 300µH
UNIT 17
D7 OA79
R2101 1k
-8V
TO UNIT 7
15kV
UNIT 15 E.H.T. UNIT
UNIT 24 ADDITIONAL POWER SUPPLY
120V~
+6V
+5V
+12V
-12V
-60V
D1878 LM301A
LINE SIGNAL TO RT90 UNIT 12
UNIT 12 INTERMEDIATE AMPLIFIER UNIT
D1551 TCA220
D1552 TCA220
D1553 TCA220
D1554 TCA220
D1555 TCA220
D1556 TCA220
-11,4V
+11,4V
-5,2V
+5,2V

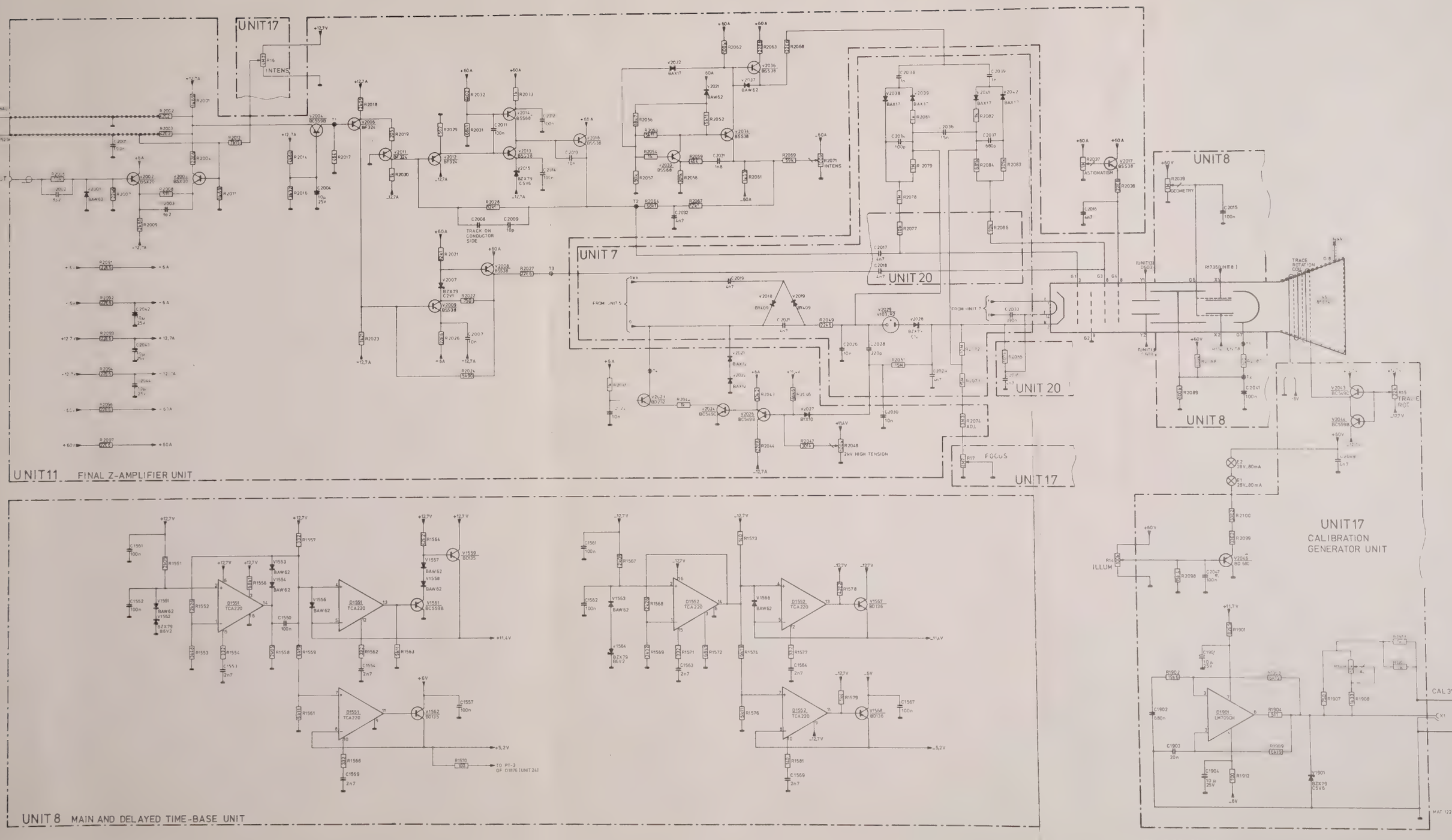


Fig. 3.69. Circuit diagram of power supply, Z-amplifier and C.R.T. circuit

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY ASSESSMENT OF T & M INSTRUMENTS

(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

① Country	② Day Month Year	③ Typenumber /Version	④ Factory/Serial no.
3 2	1 5 0 4 7 5	0 P M 3 2 6 0 0 2	D O 0 0 7 8 3

CODED FAILURE DESCRIPTION ⑥

⑤ Nature of call	Location	Component/sequence no.	Category
☐ Installation		T S 0 6 0 7	5
☐ Pre sale repair		R 0 0 6 3 1	2
☐ Preventive maintenance	0 0 2 1	9 9 0 0 0 1	4
☒ Corrective maintenance			
☐ Other			

⑦ *Job completed* ☒

Working time ⑧ ☐☐12 Hrs

Detailed description of the information to be entered in the various boxes:

①Country: 3 2 = Switzerland

②Day Month Year 1 5 0 4 7 5 = 15 April 1975

③Type number/Version O P M 3 2 6 0 0 2 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number D O 0 0 7 8 3 = DO 783 These data are mentioned on the type plate of the instrument

⑤ Nature of call: Enter a cross in the relevant box

⑥ Coded failure description

Location

☐☐☐☐

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).

Example: 0001 for Unit 1
000A for Unit A
0075 for item 75

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

☐☐☐☐☐☐

These six boxes are intended to pinpoint the faulty component.

A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric,the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.

B. Parts not identified in the circuit diagram:

990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve,transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

☐

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦ Job completed: Enter a cross when the job has been completed.

⑧ Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

☐☐12 = 1,2 working hours (1 h 12 min.)

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